



Nue Phone Mtg  
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# MRCC Study (corrected version)

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# Introduction

- This is a replacement of two talks doc-3841 and doc-3864 after I found a bug in my code.
- The purpose of this study is to understand the efficiency of muon removal algorithm which is important for the NC background estimate in the nue analysis.
- The concern is that there might be muon remnants in the MRCC events.
- One way to study the muon removal efficiency is to compare the MRCC sample with a **special** CC sample where muon is “completely” removed.



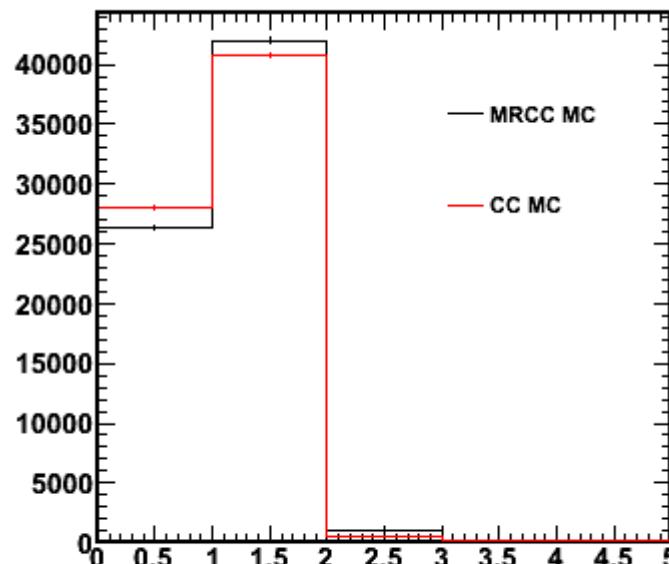
# Two Approaches

- There are two ways to generate such a special CC sample:
  - Remove the muon at the generator level.
  - Remove scintillator hits generated by a muon or its daughters.
- The second approach is much easier
  - Got useful suggestions from Nathaniel.
  - Modified PhotonTransport to “turn off” all muon hits.
    - This includes electrons from muon decay, delta rays, bremsstrahlung and crosstalk caused by the muon.
- Reprocessed some MC files with this change (using R1.24.1).

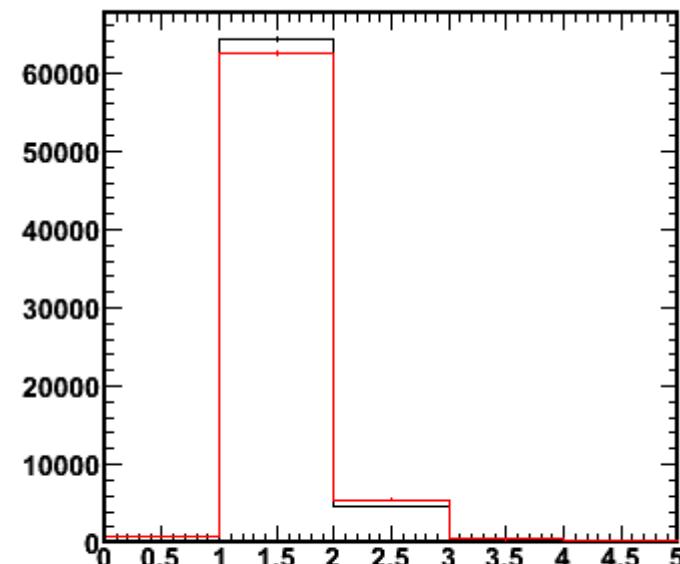


# #tracks and #showers

#tracks



#showers

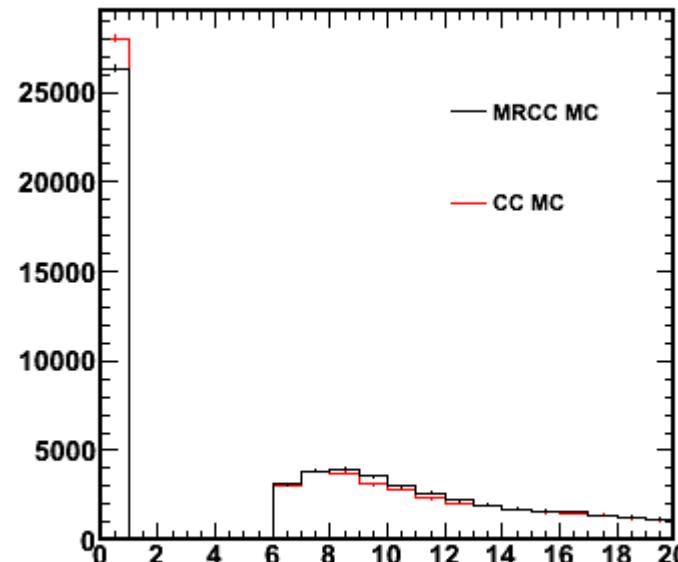


- Match MRCC event with special CC event based on true Enu and y information (exactly the same events in both samples).
- Fiducial volume cut and MRE pre-selection cut applied.
- There are slightly more tracks in the MRCC sample.
- These plots look much better than before.

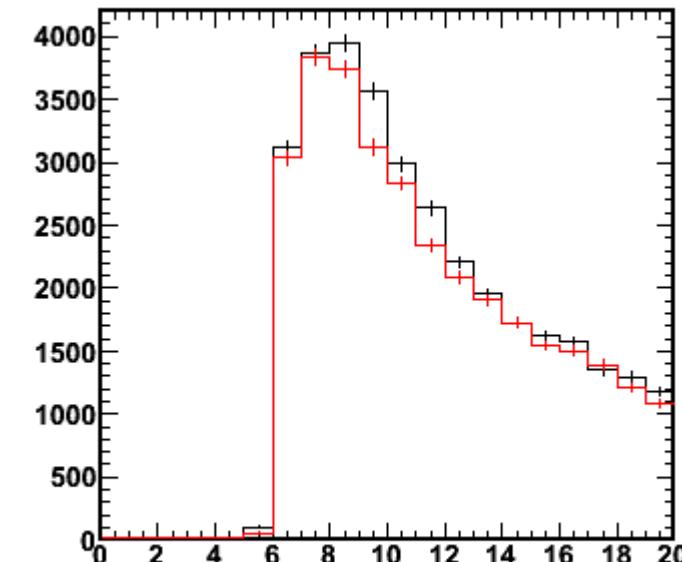


# Track Length

#track planes



#track planes

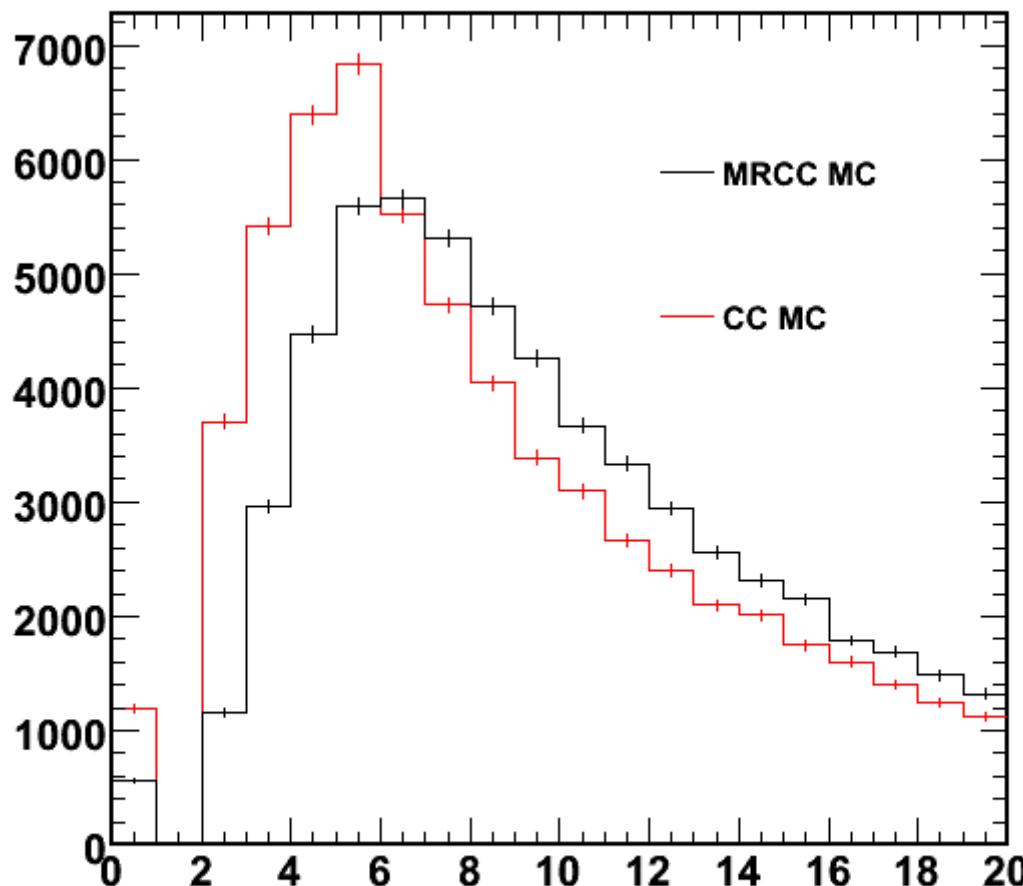


- The left plot excludes the events with no track reconstructed.
- The track length distributions agree quite well between two samples.



# Shower Length

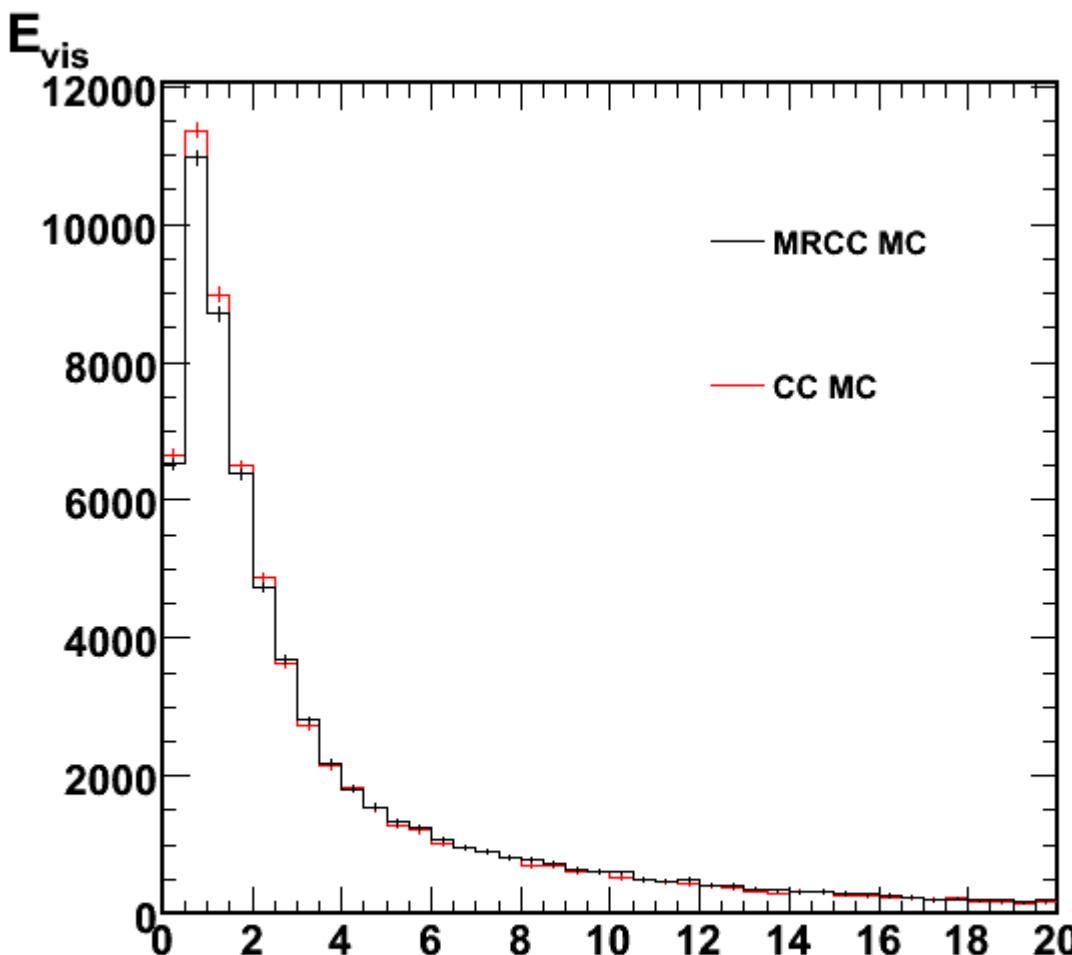
#shower planes



- MRCC events have longer showers
- This might indicate that sometimes muon remnants get merged into the shower.



# Total Reco Energy

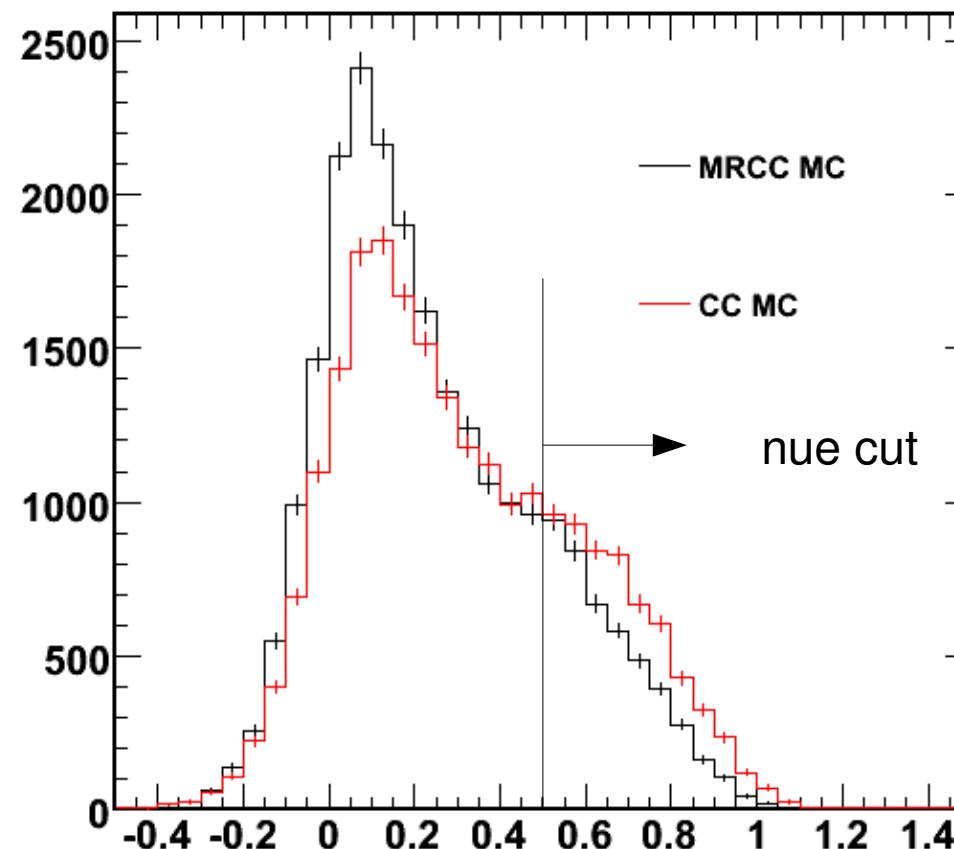


MRCC events have slightly higher reco energy.



# ANN PID

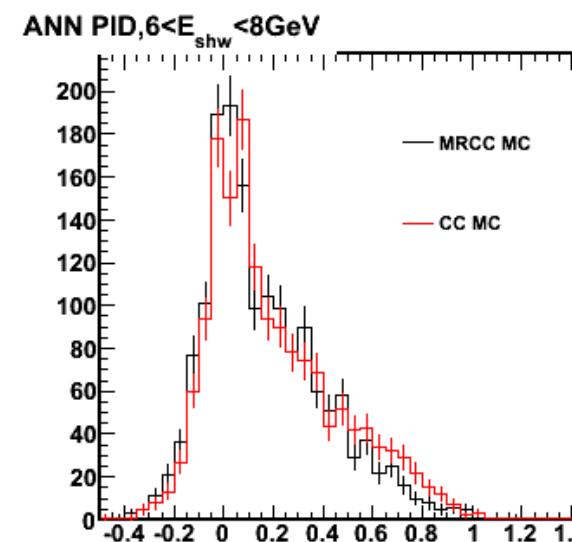
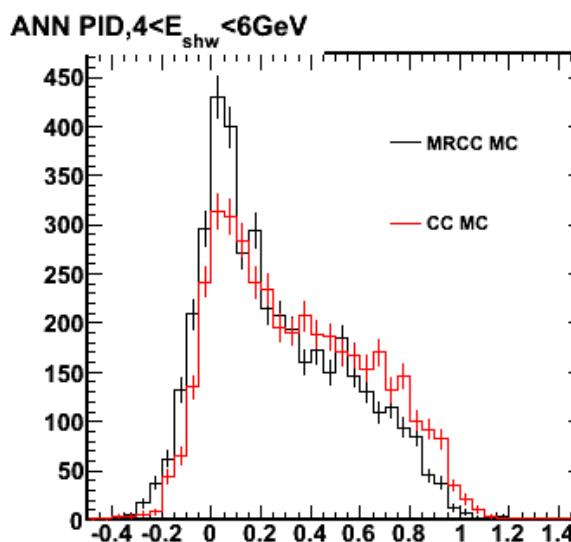
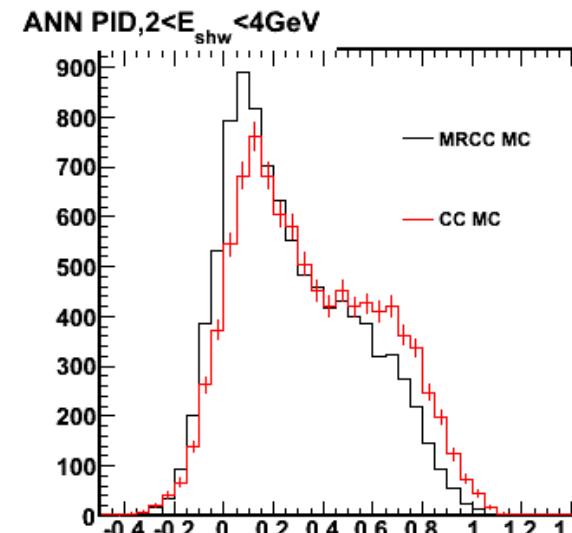
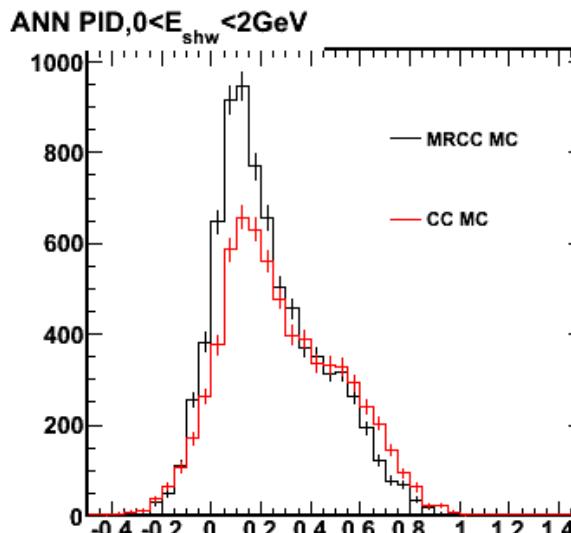
ANN PID



- Fiducial volume cuts and nue pre-selection cuts applied.
- Normalized to the same total number of input events (after fiducial volume cuts).
- CC events are more likely to pass the nue cut than MRCC events.

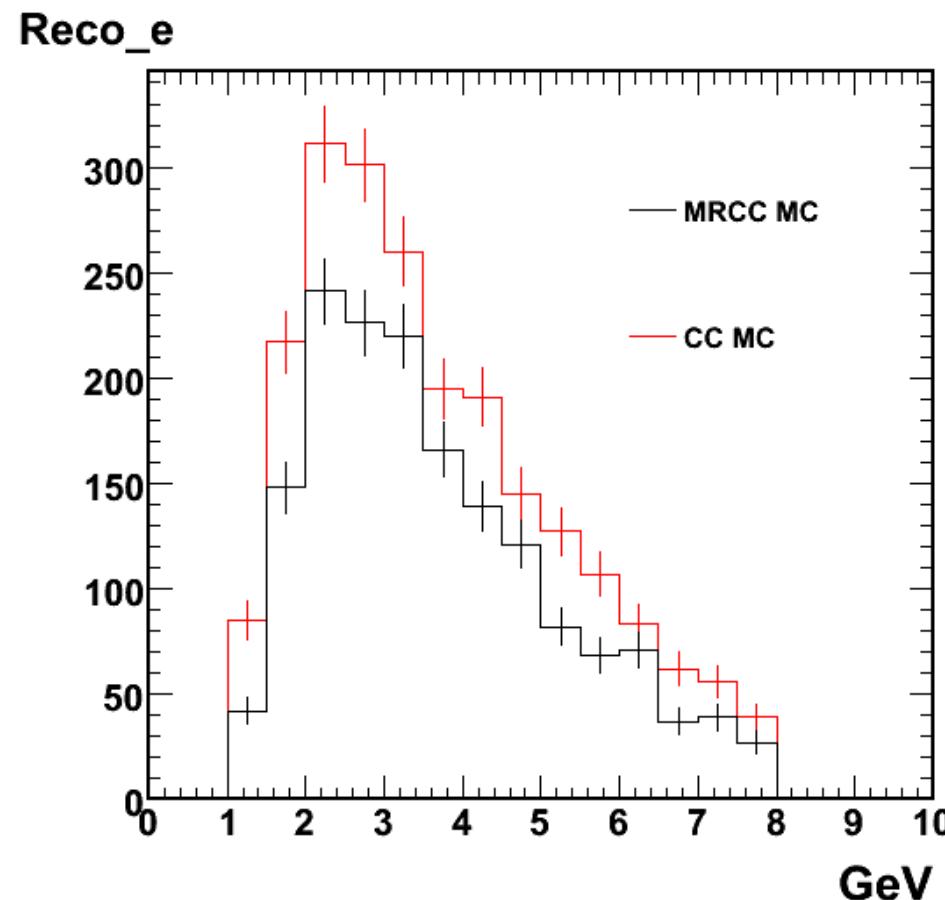


# ANN PID in $E_{\text{shw}}$ Bins





# Reco E after PID Cut>0.5



- MRCC:  $1627 \pm 40$  CC:  $2179 \pm 47$
- There is about 30% difference between those two samples after nue cuts.



# Conclusions

- There seems to be muon remnants in the MRCC events
  - bigger showers
- It makes more sense to use MRCC data/MC ratio to correct the standard MC since the differences may cancel out in the ratio.

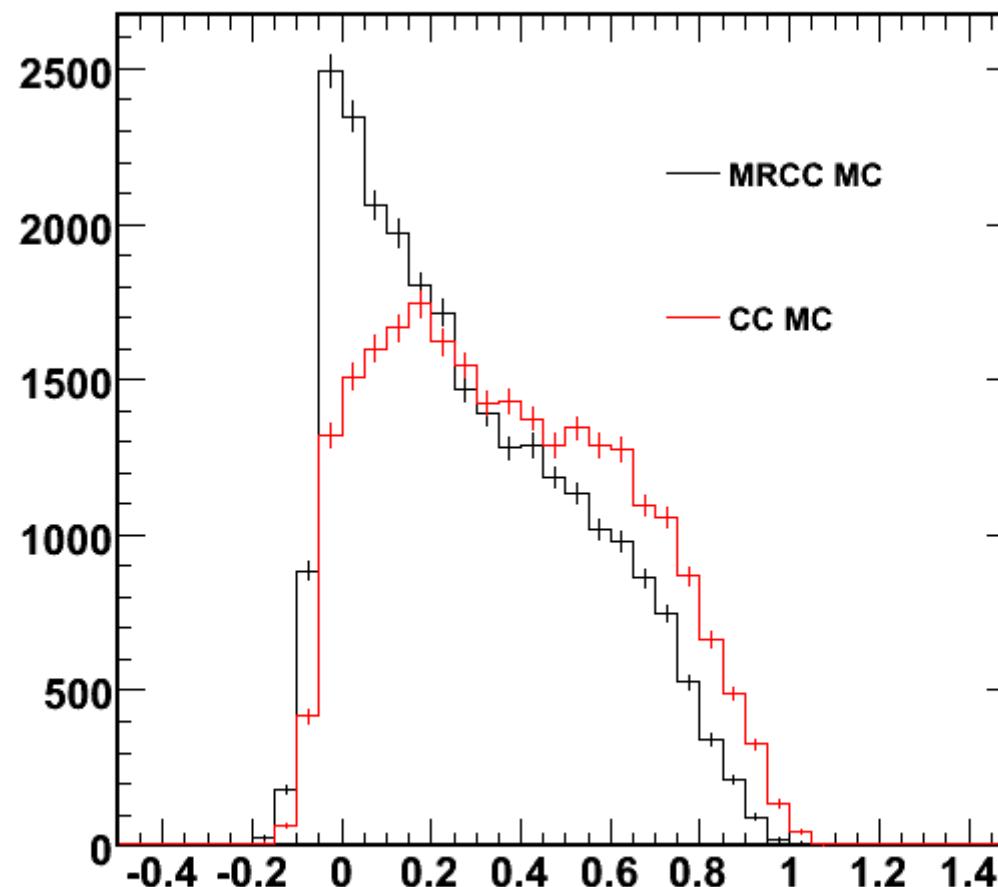


# Backup slides



# SS PID

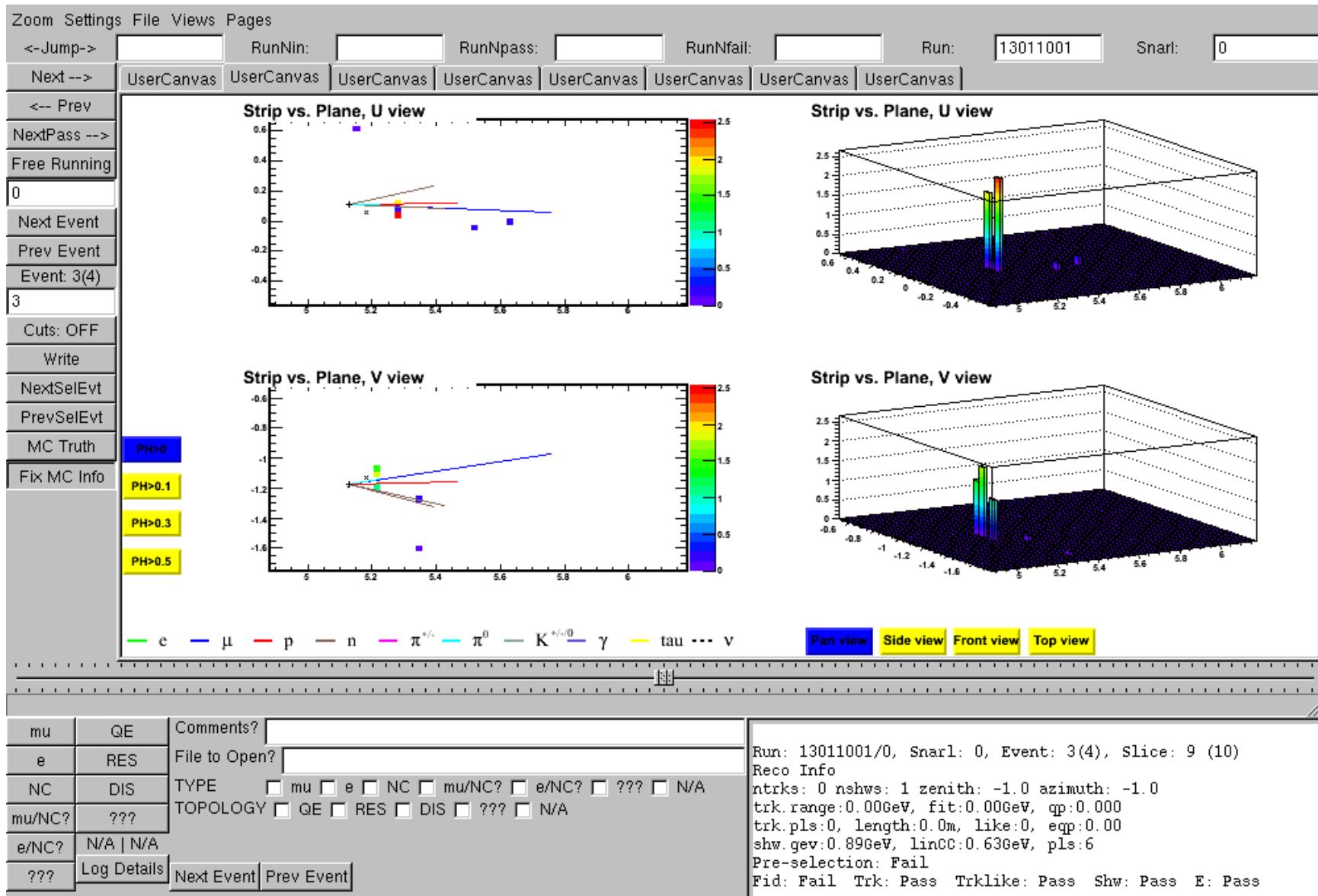
SS PID



Same feature as ANN PID.

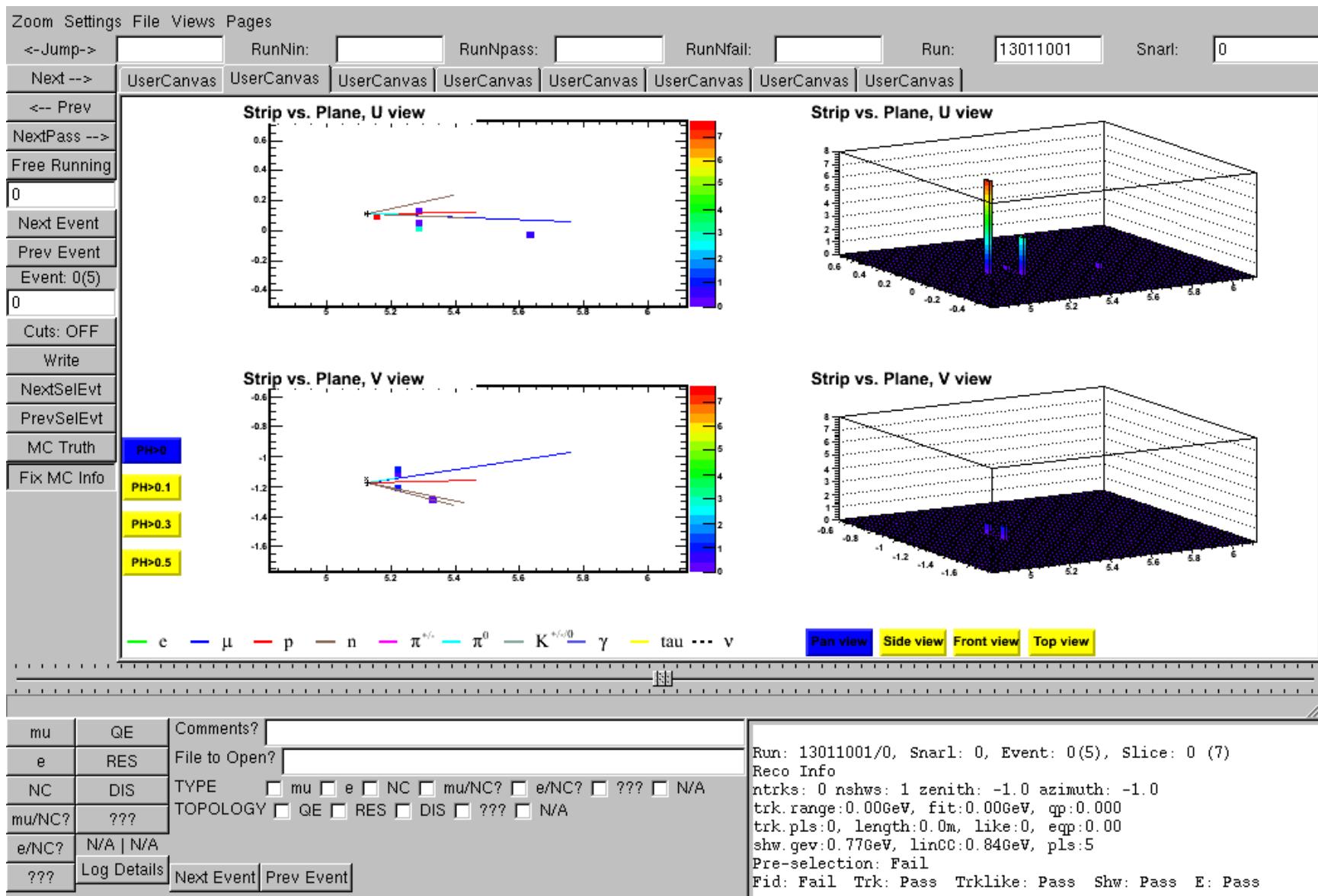


# MRCC Event 1



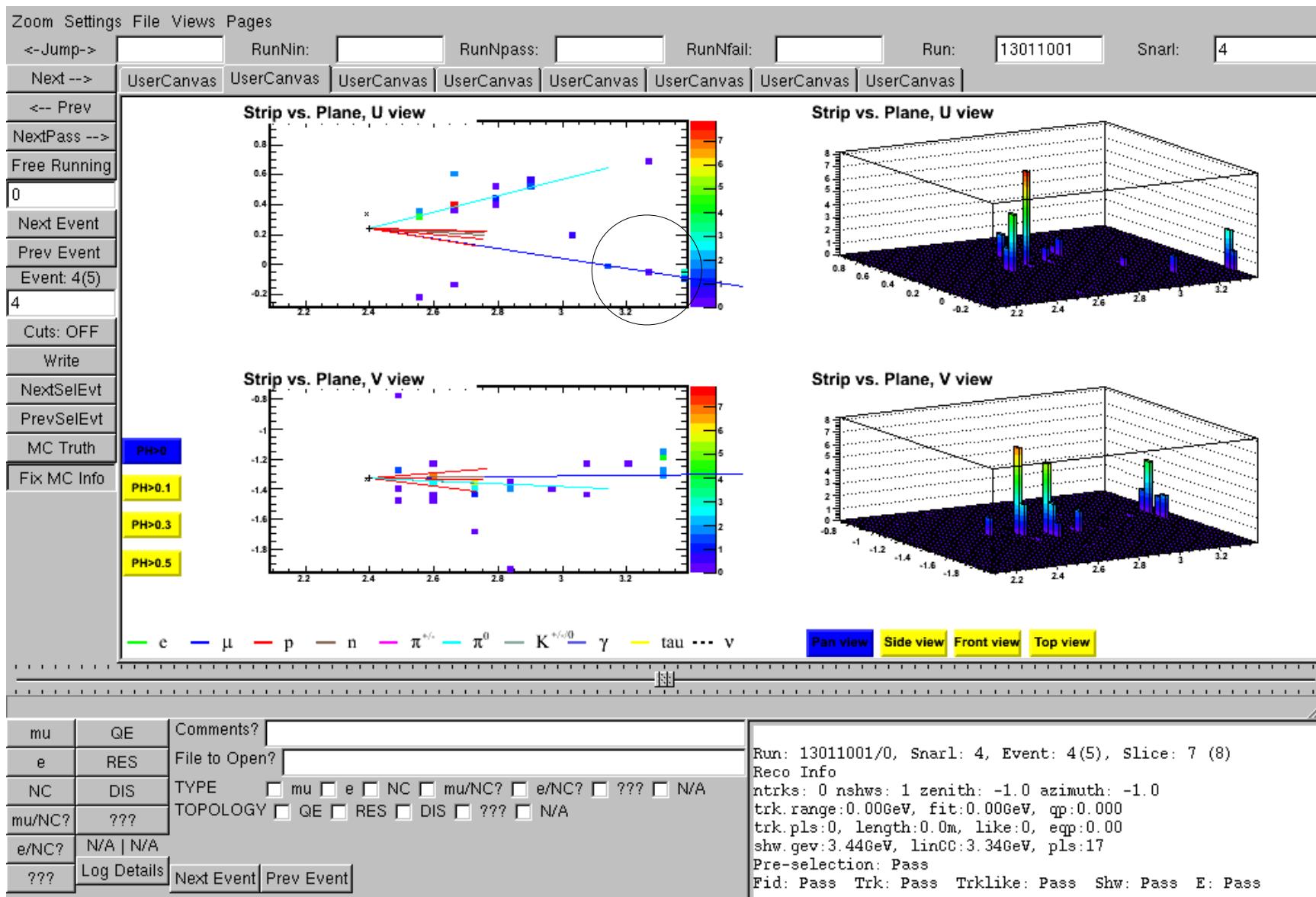


# CC Event 1



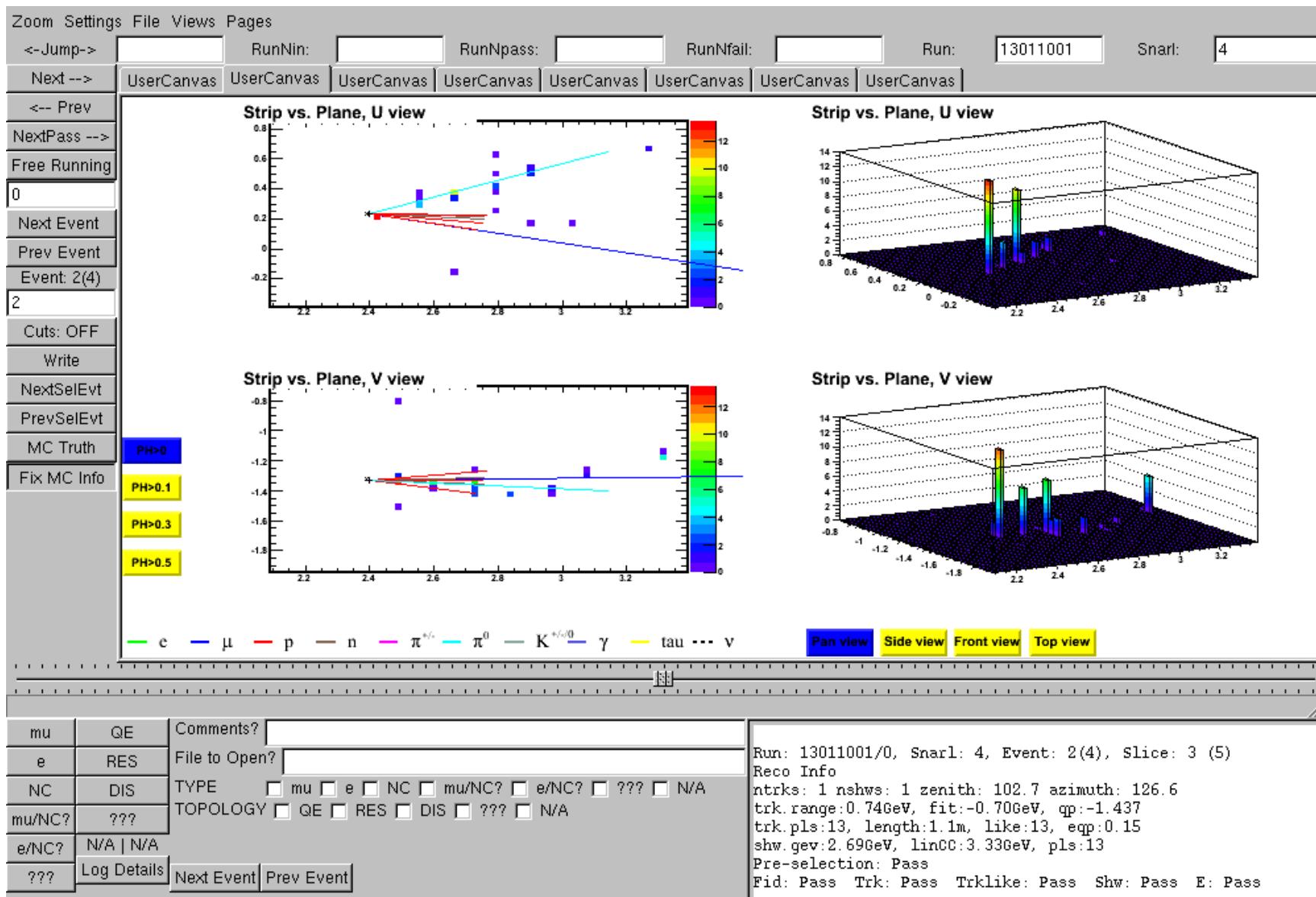


# MRCC Event 2



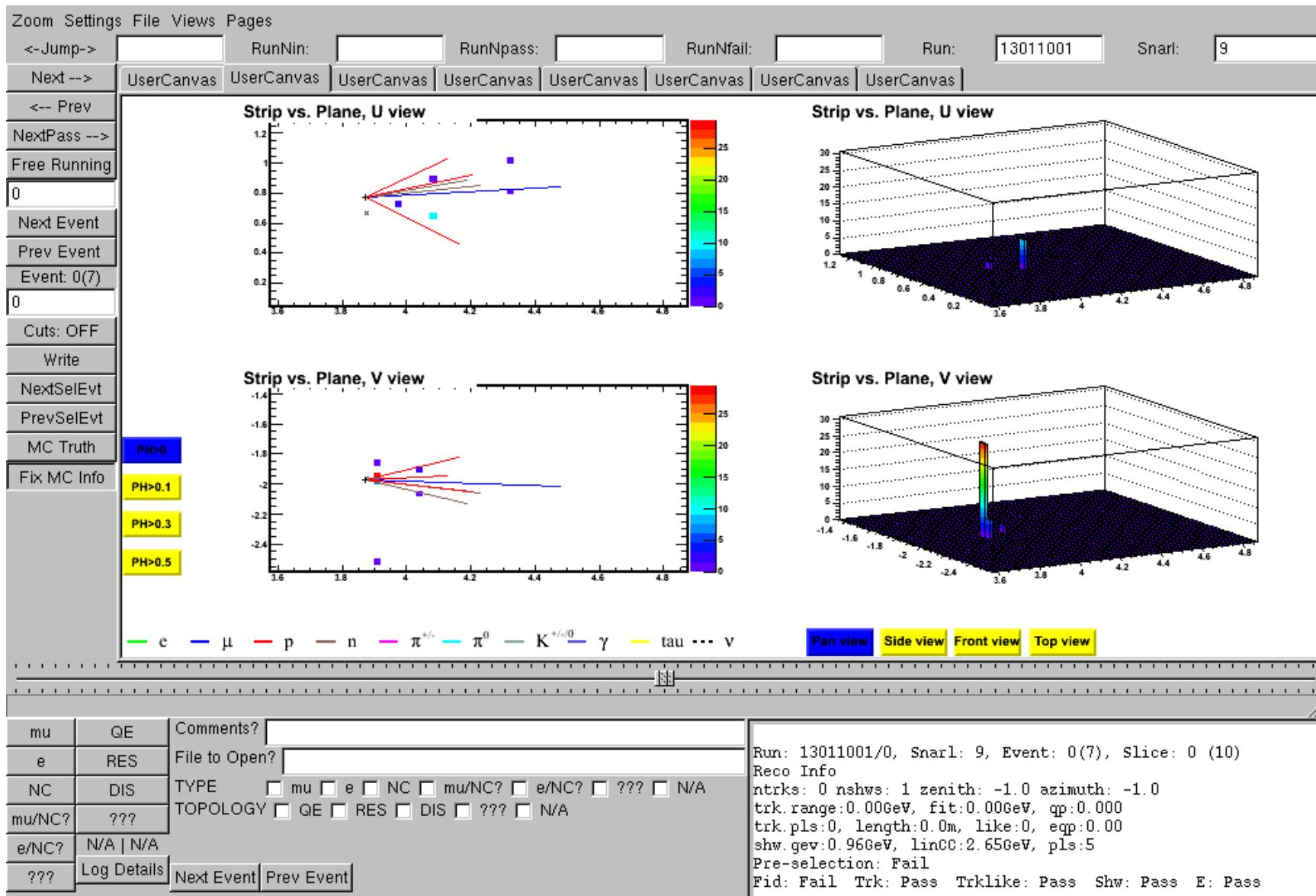


# CC Event 2



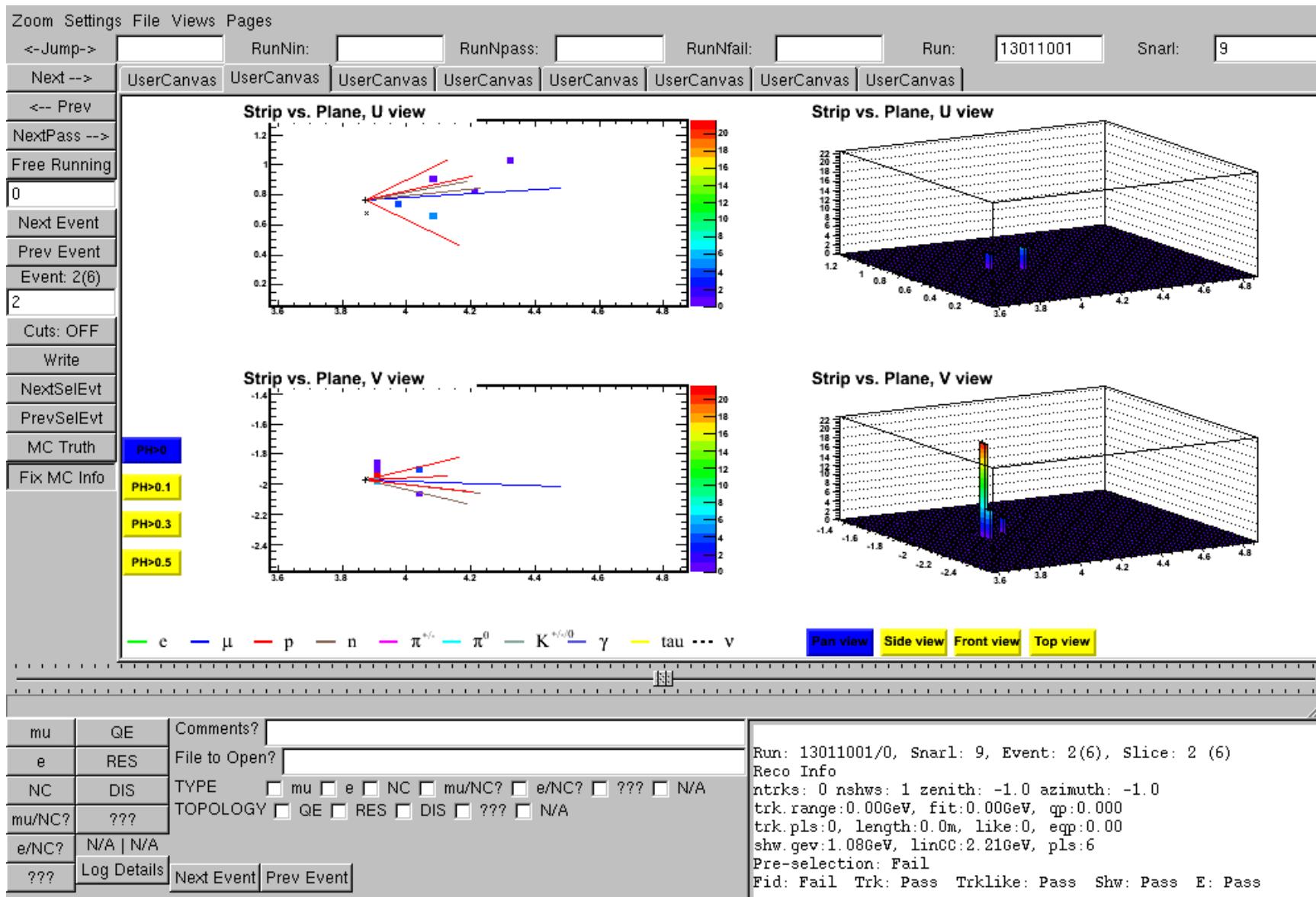


# MRCC Event 3



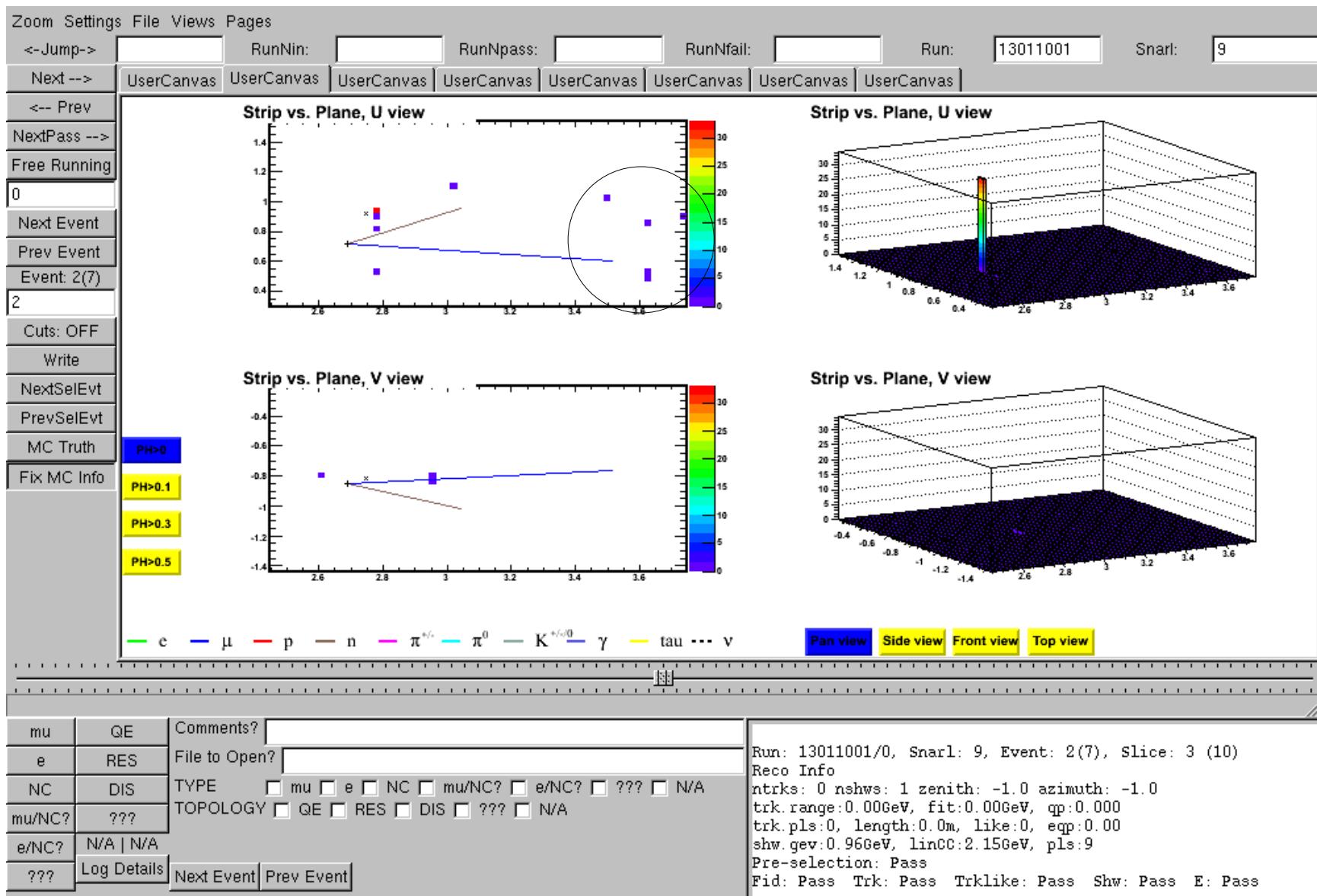


# CC Event 3



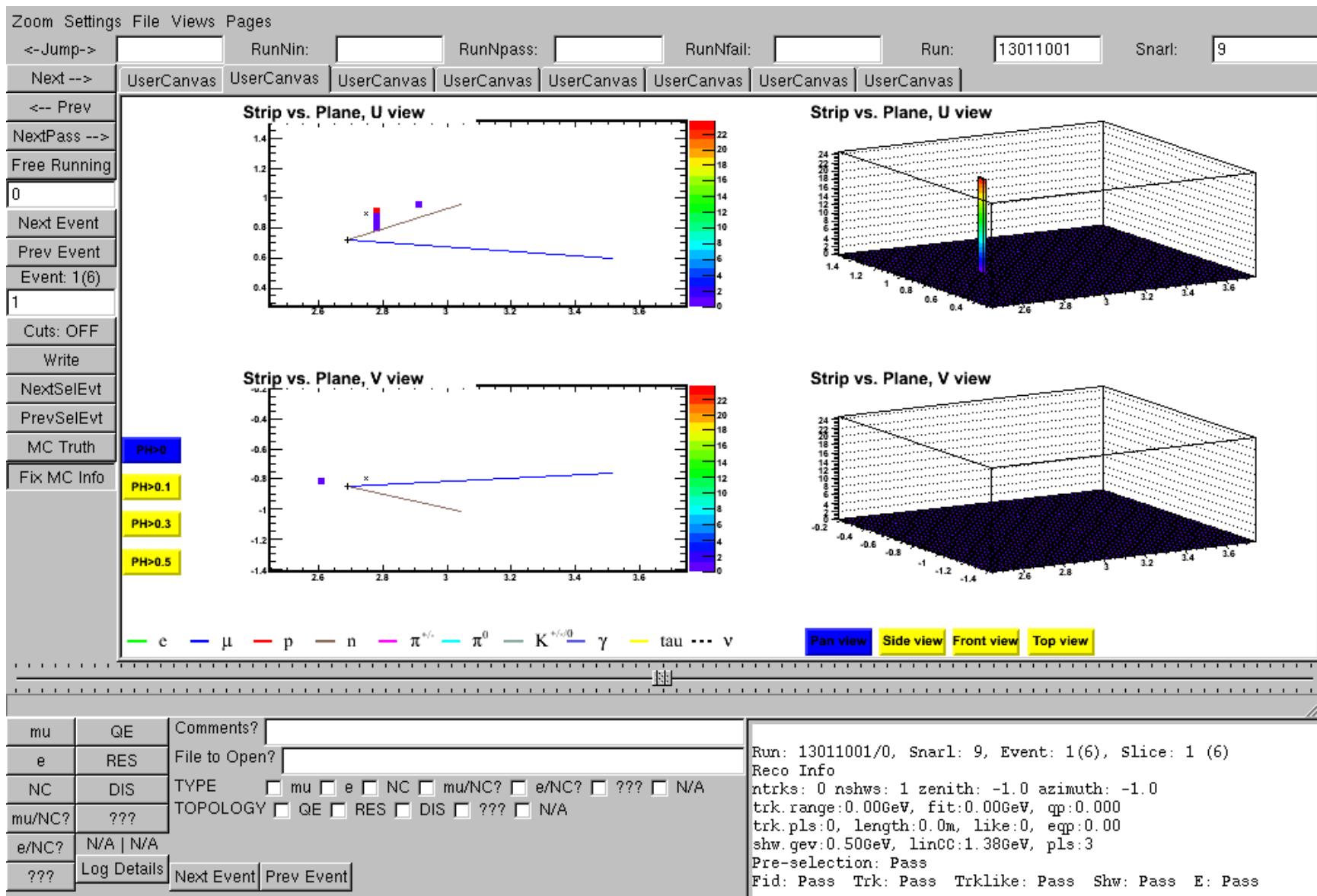


# MRCC Event 4



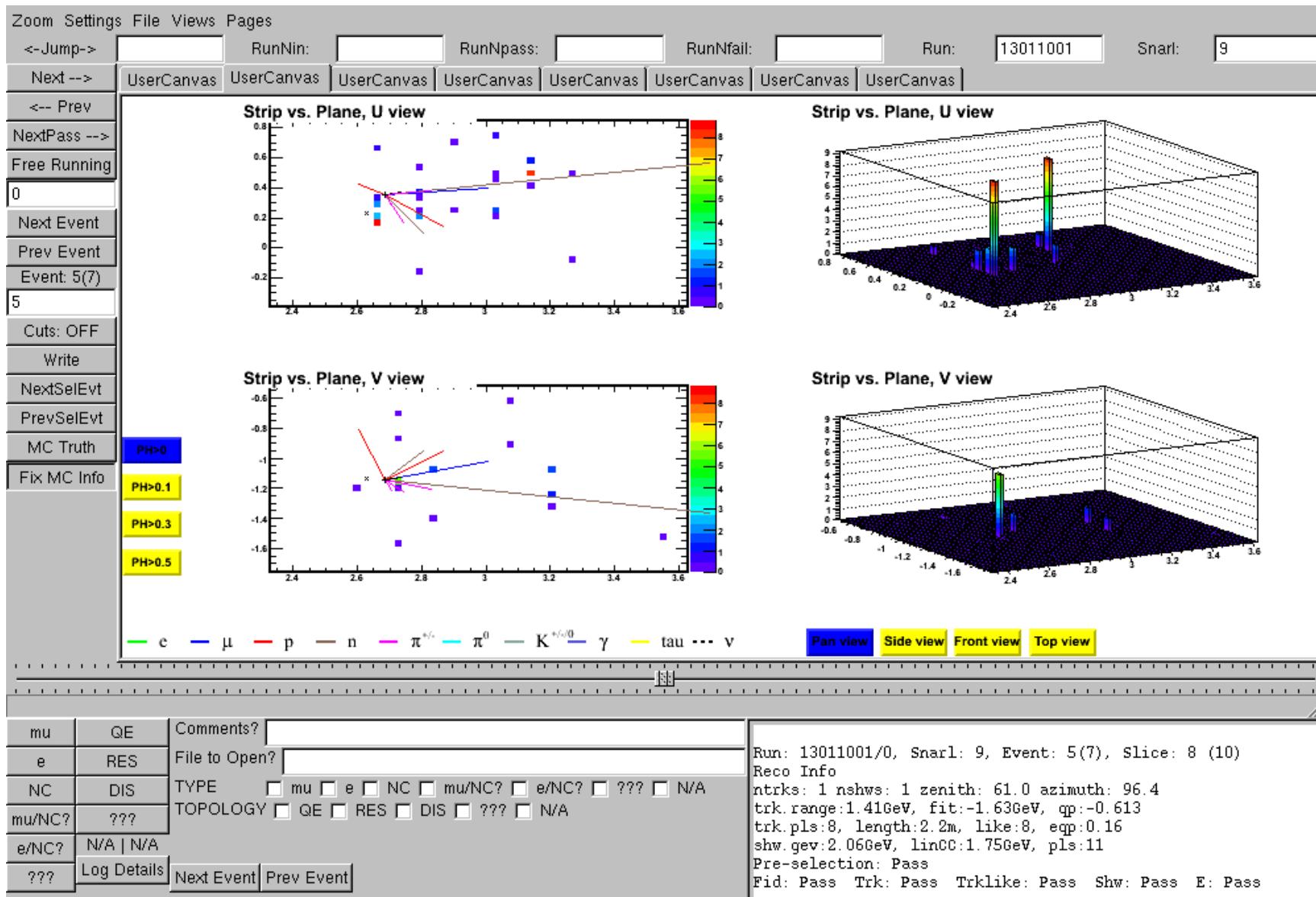


# CC Event 4



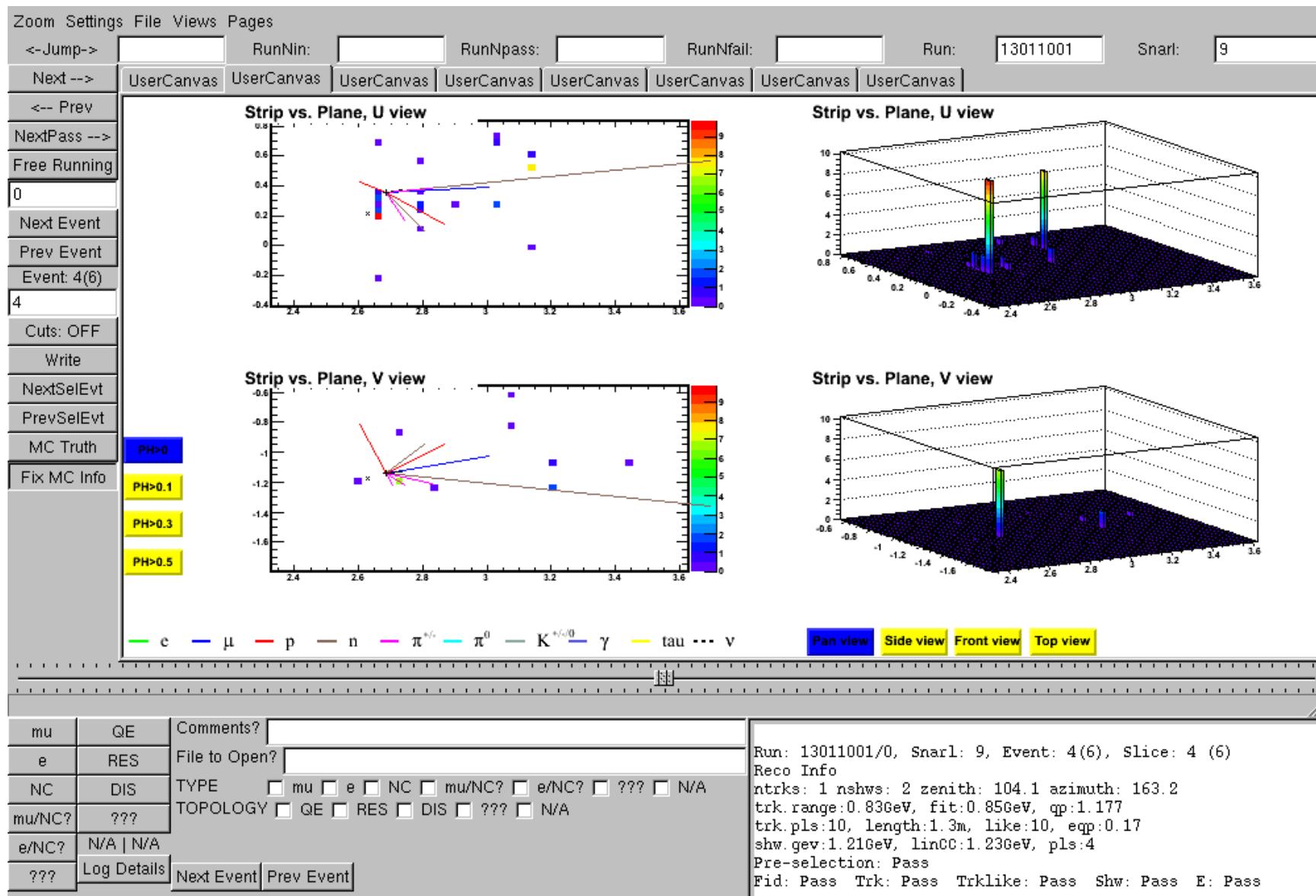


# MRCC Event 5



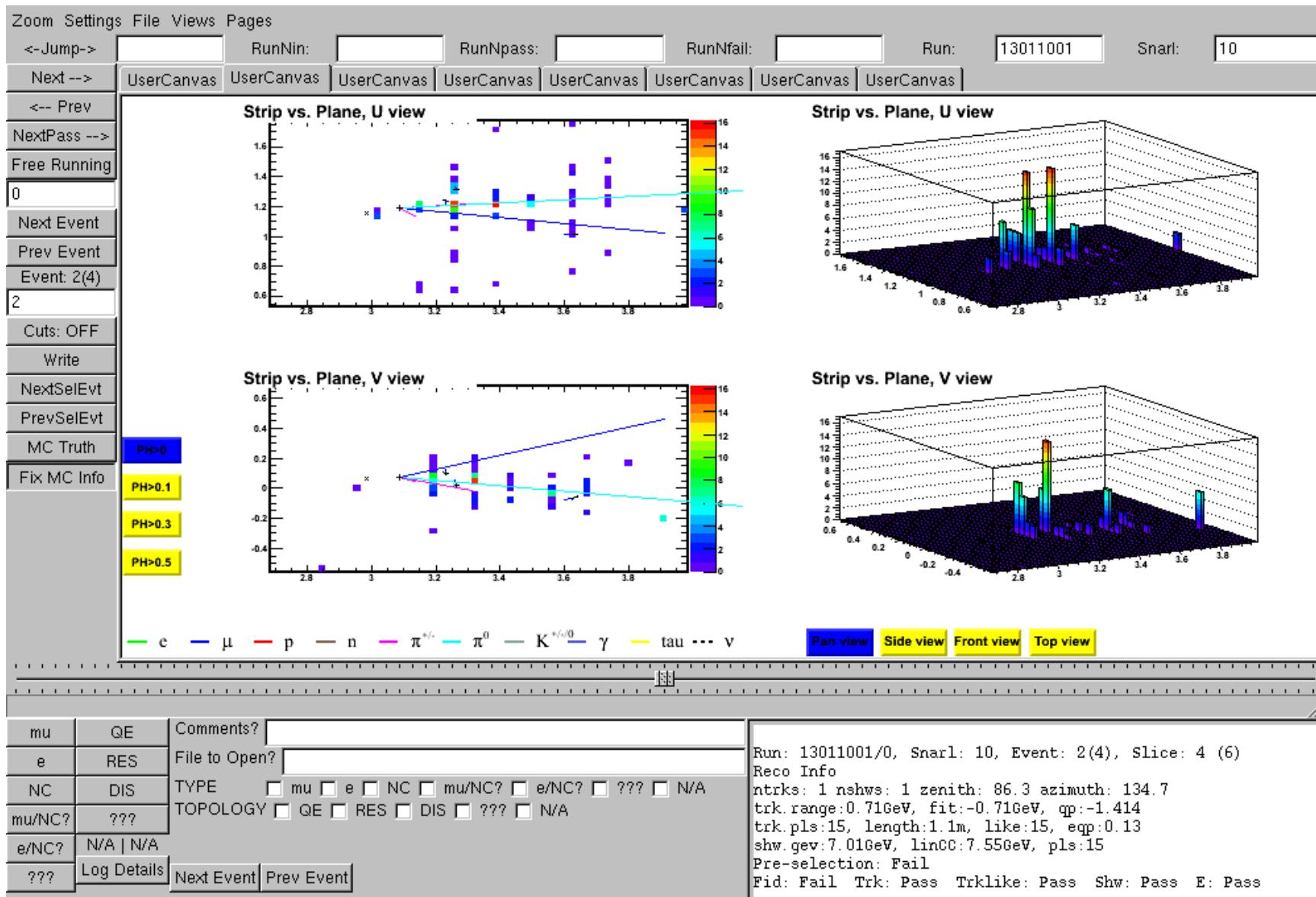


# CC Event 5



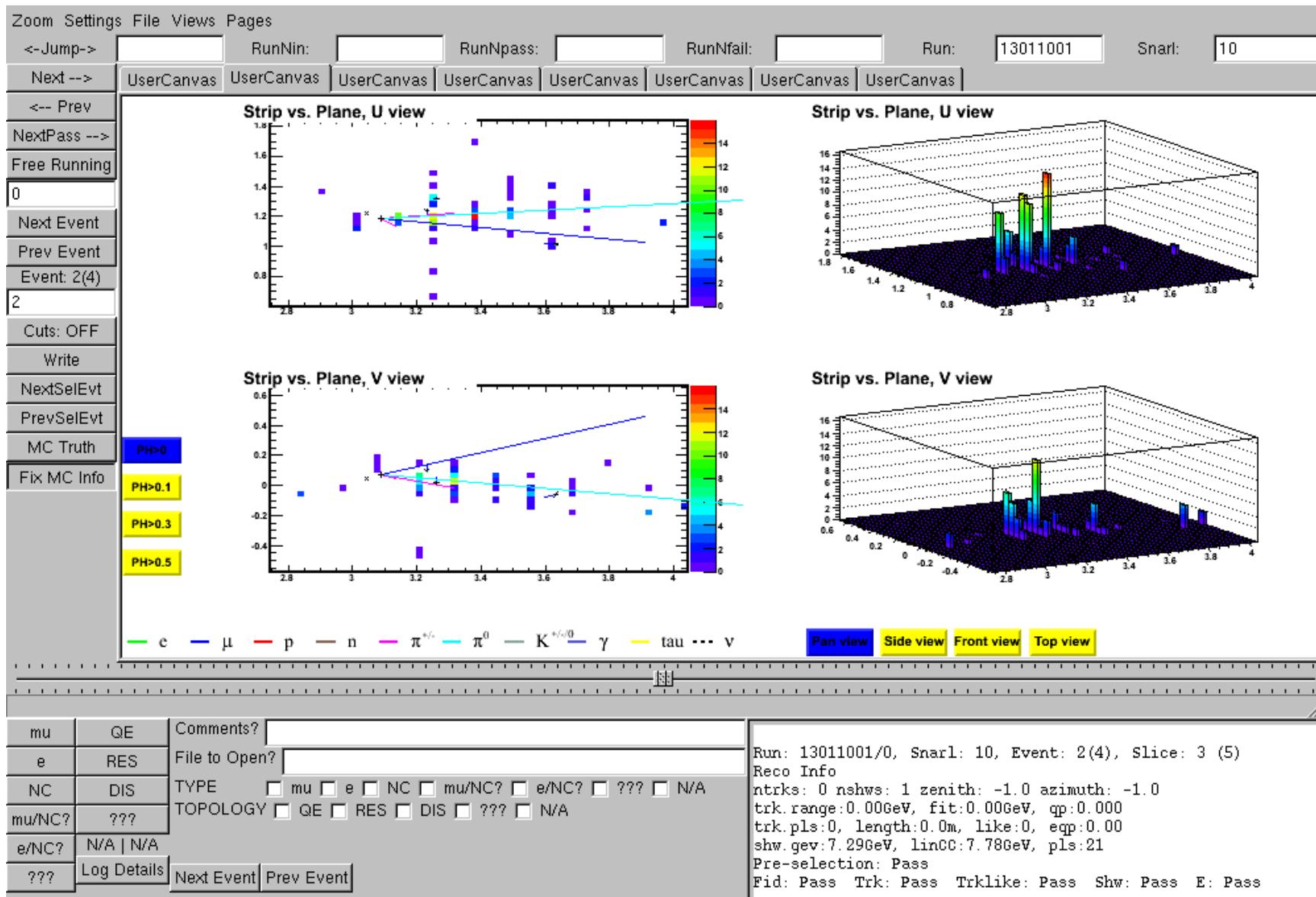


# MRCC Event 6



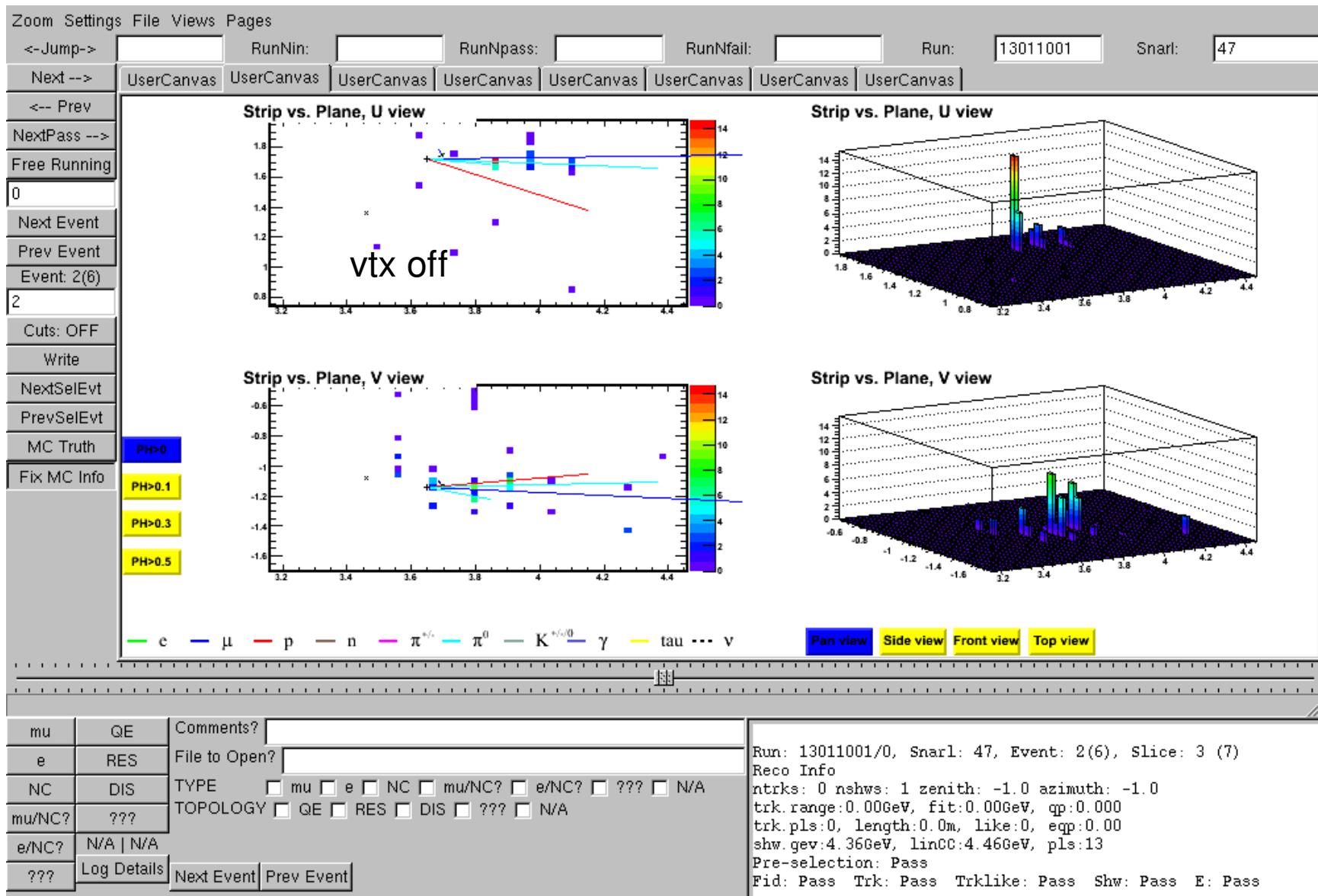


# CC Event 6



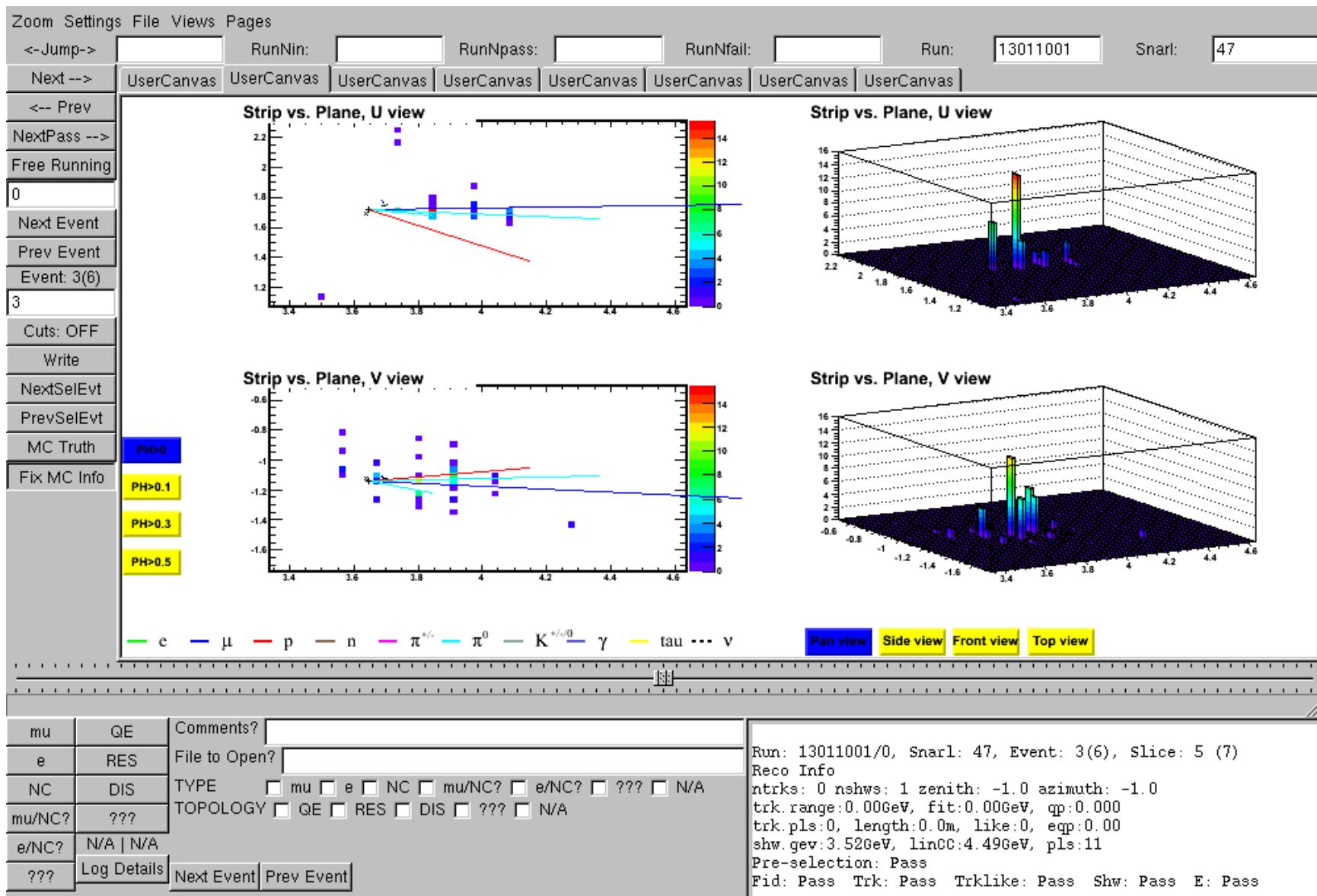


# MRCC Event 7



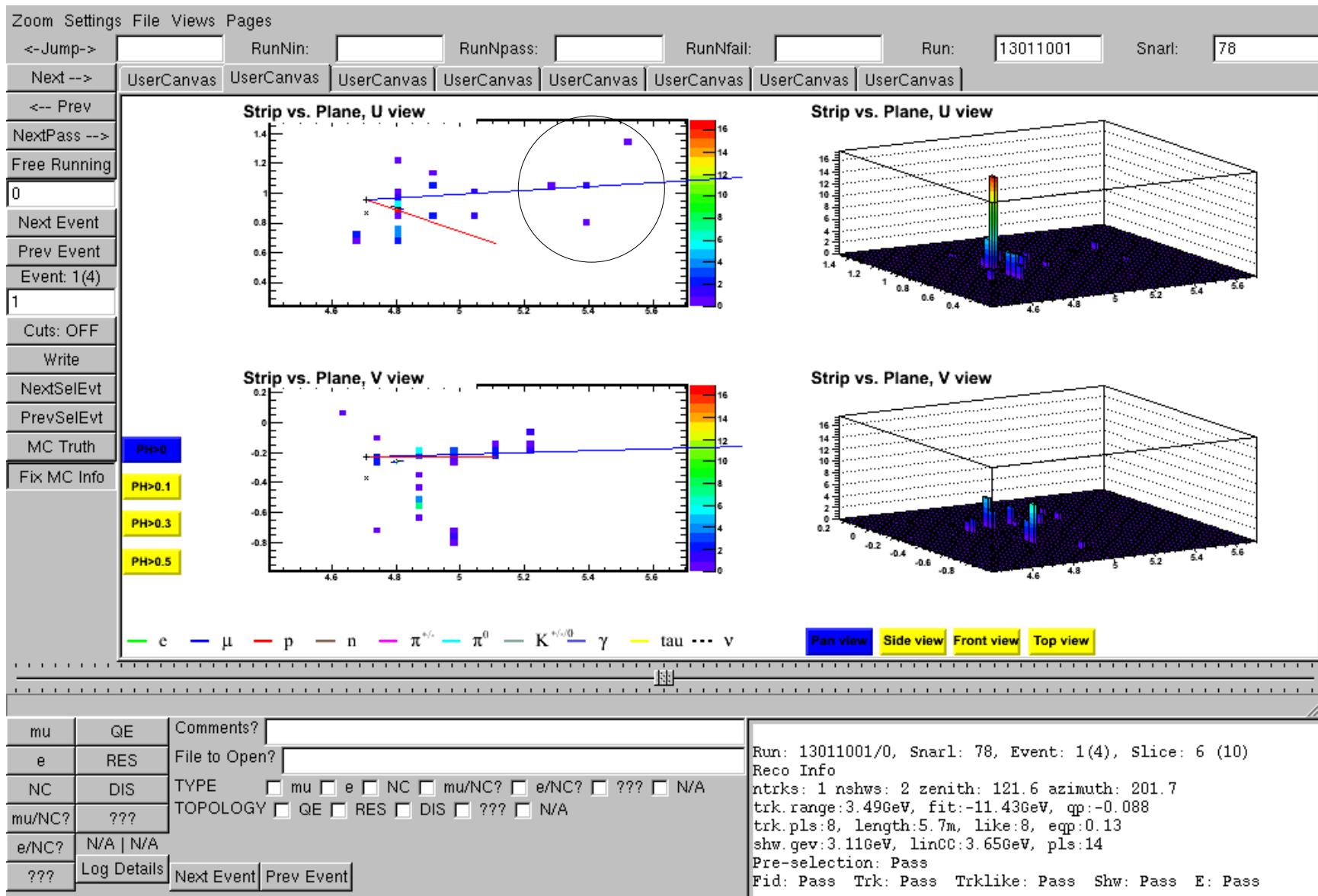


# CC Event 7



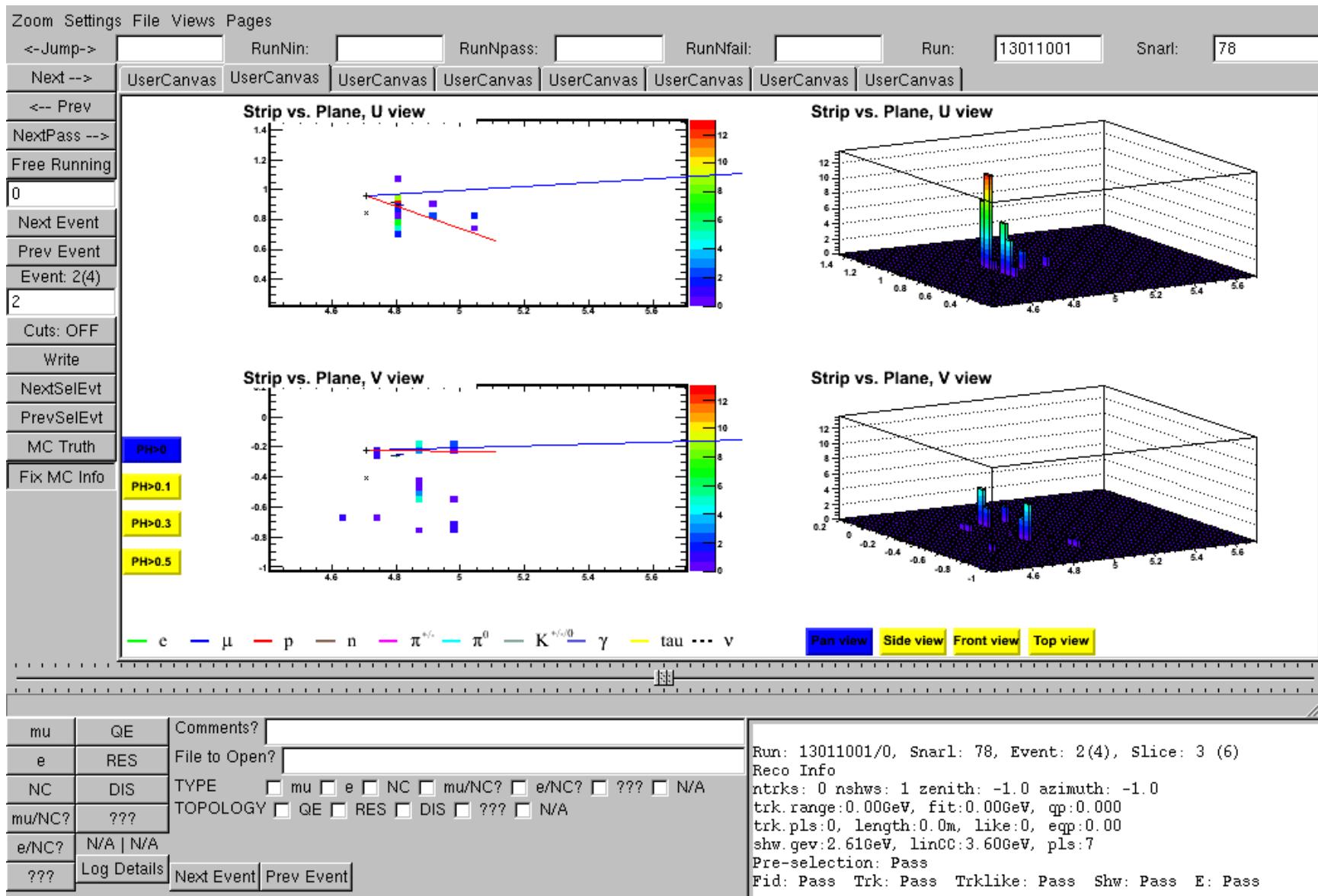


# MRCC Event 8



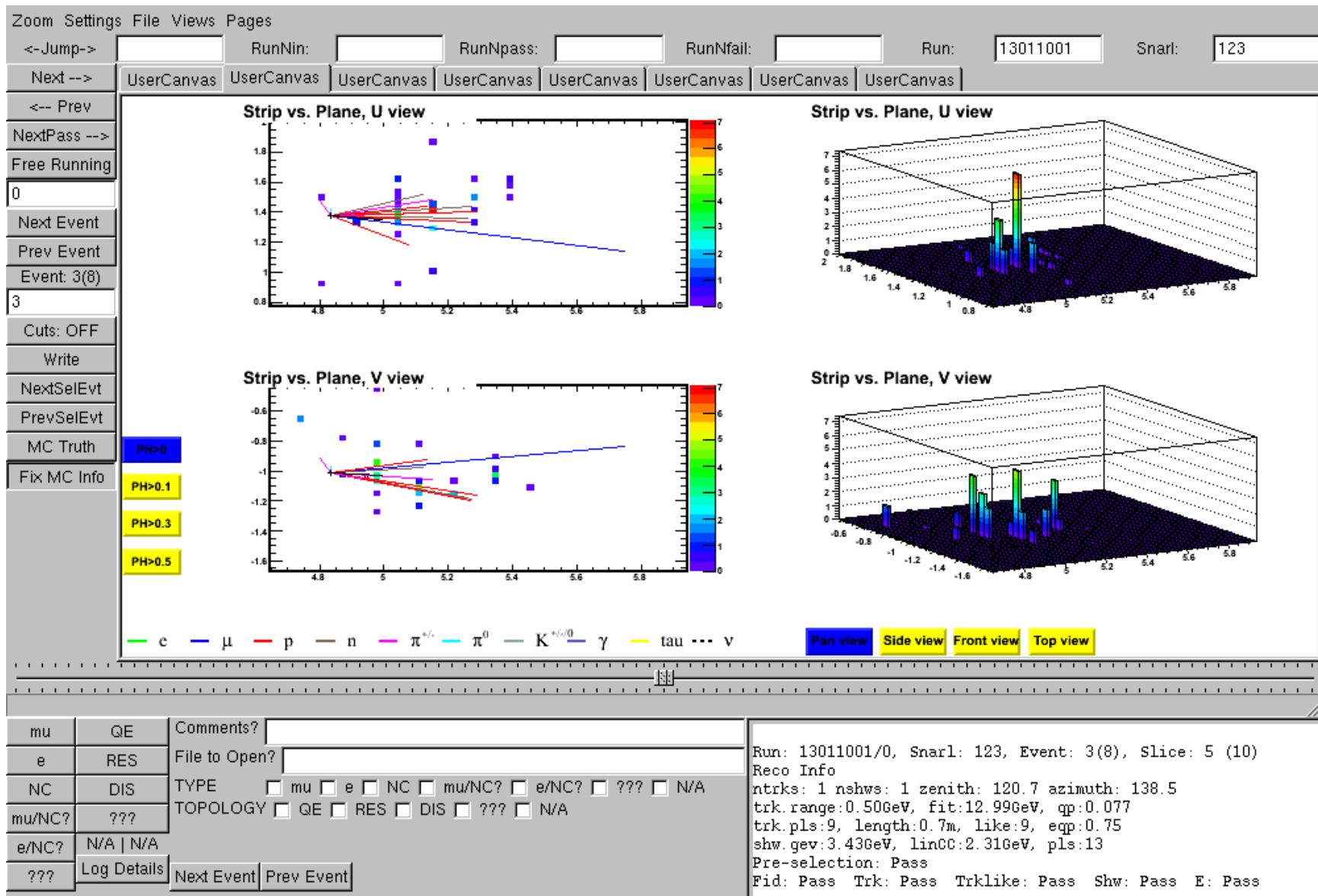


# CC Event 8



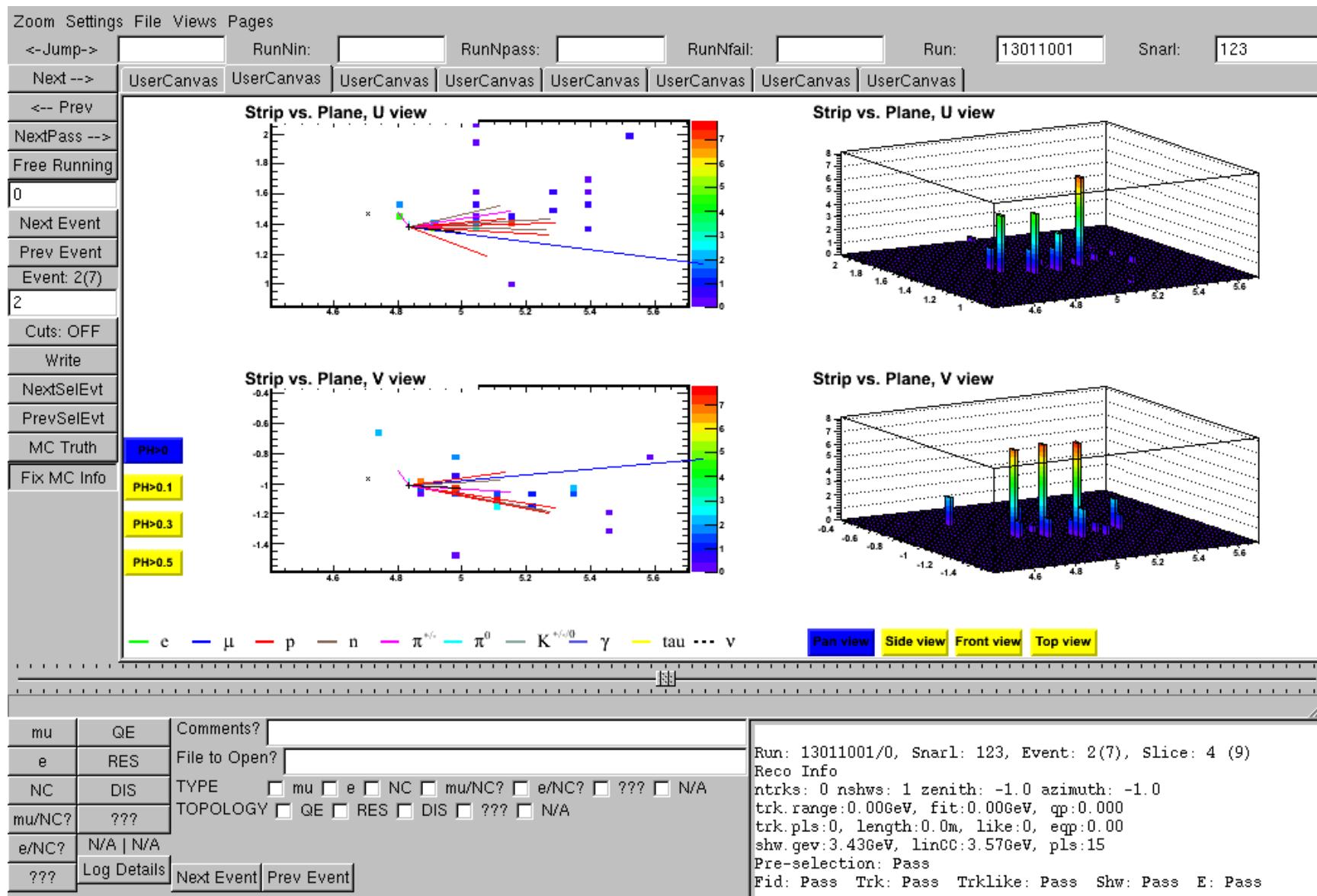


# MRCC Event 9



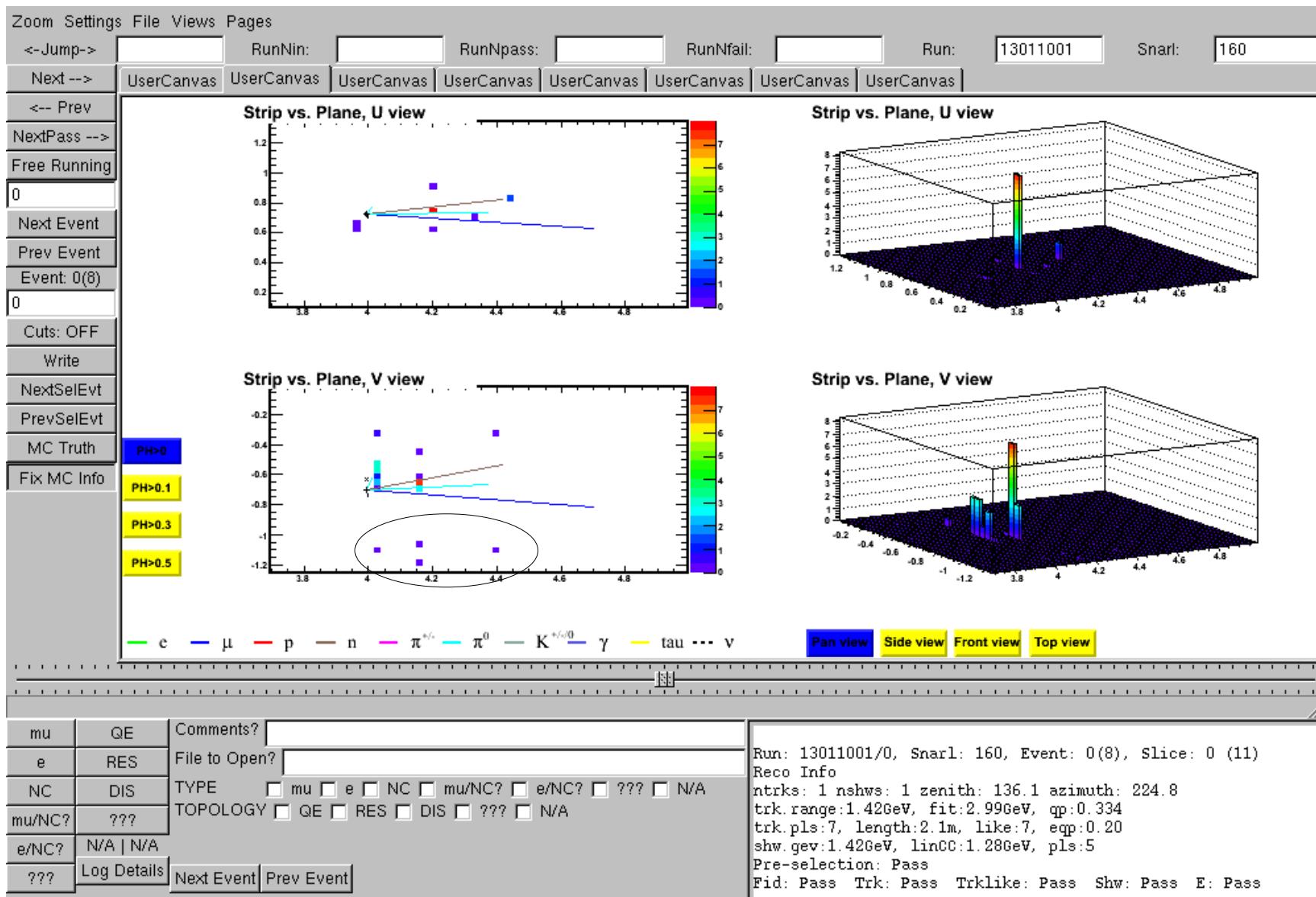


# CC Event 9



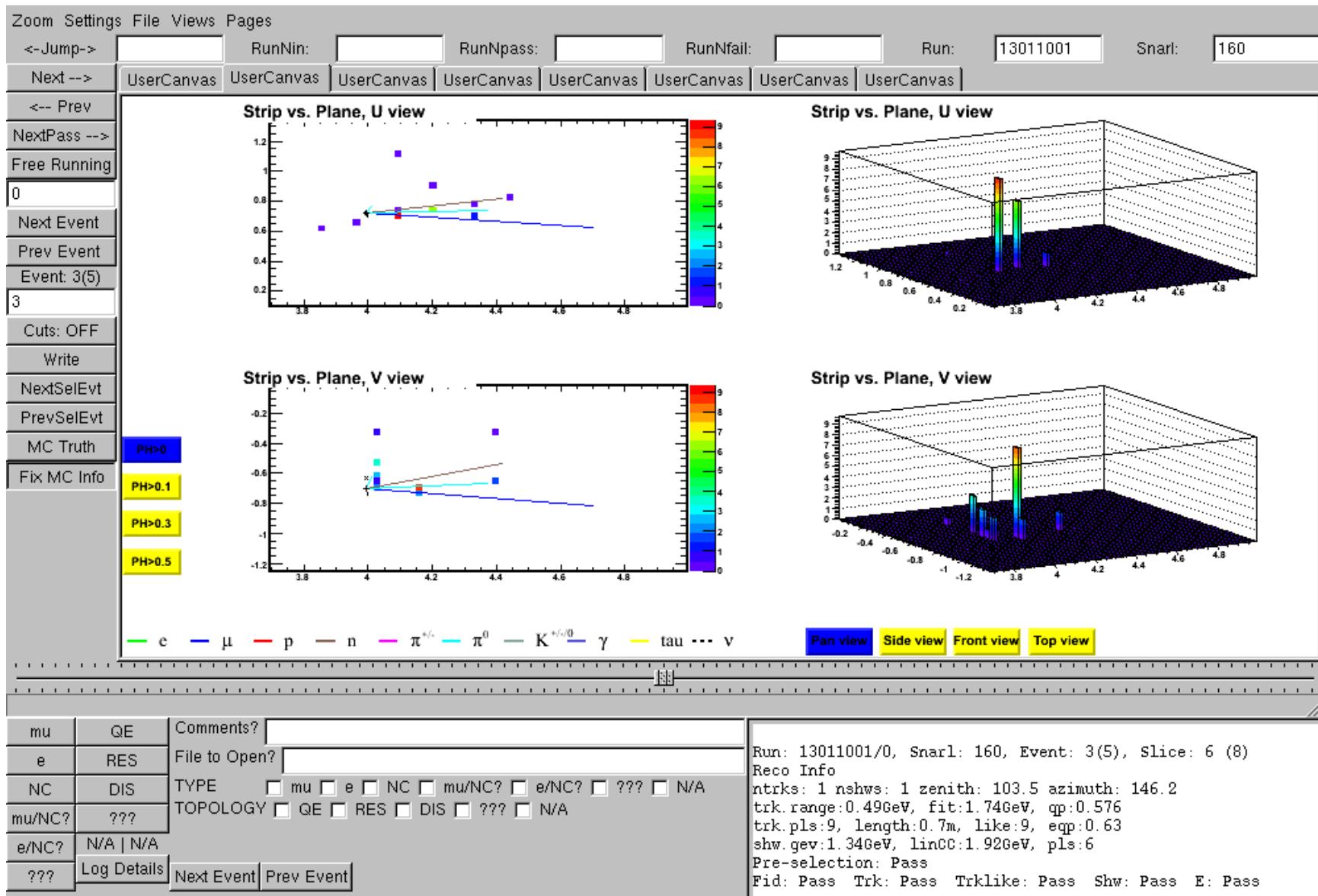


# MRCC Event 10



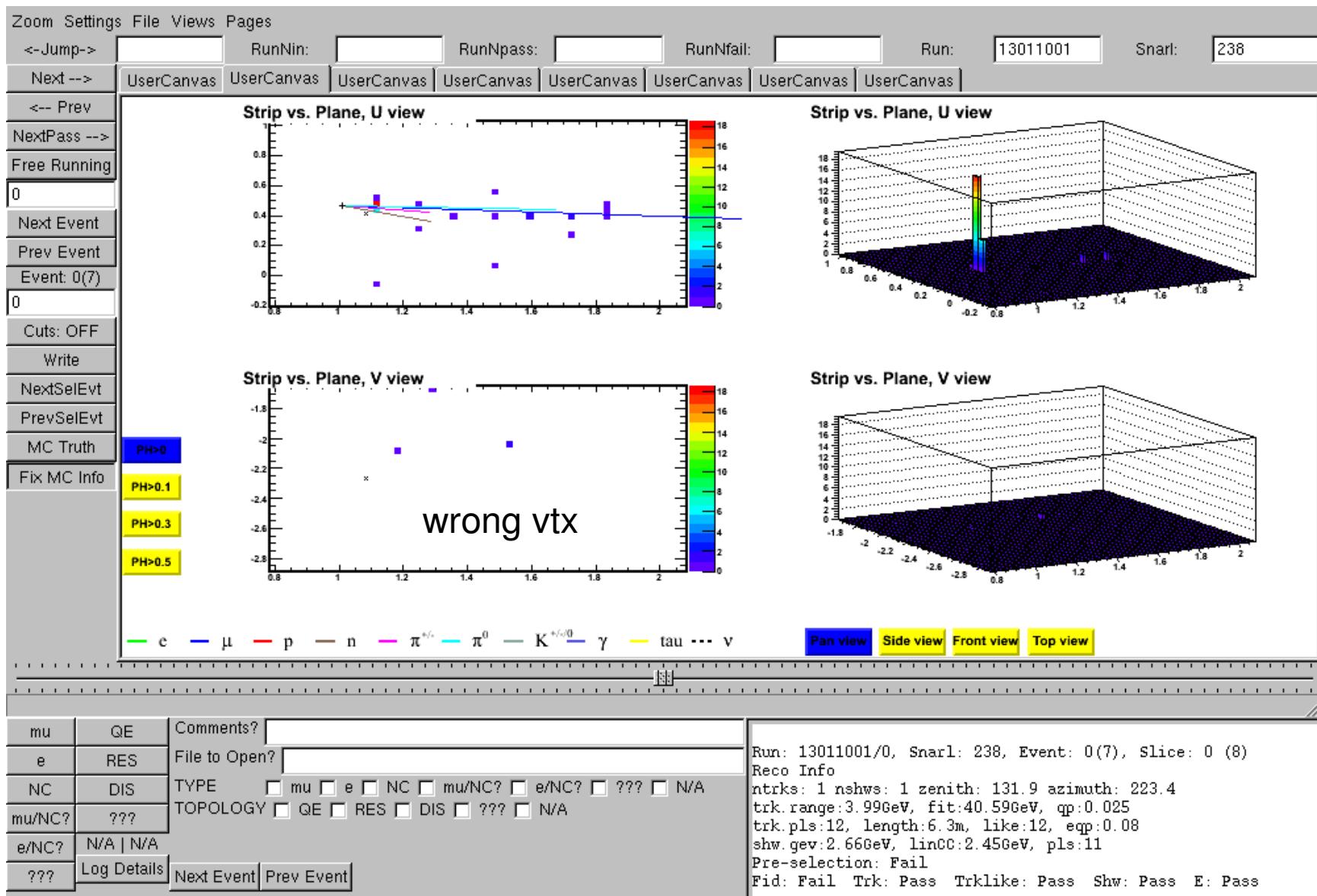


# CC Event 10



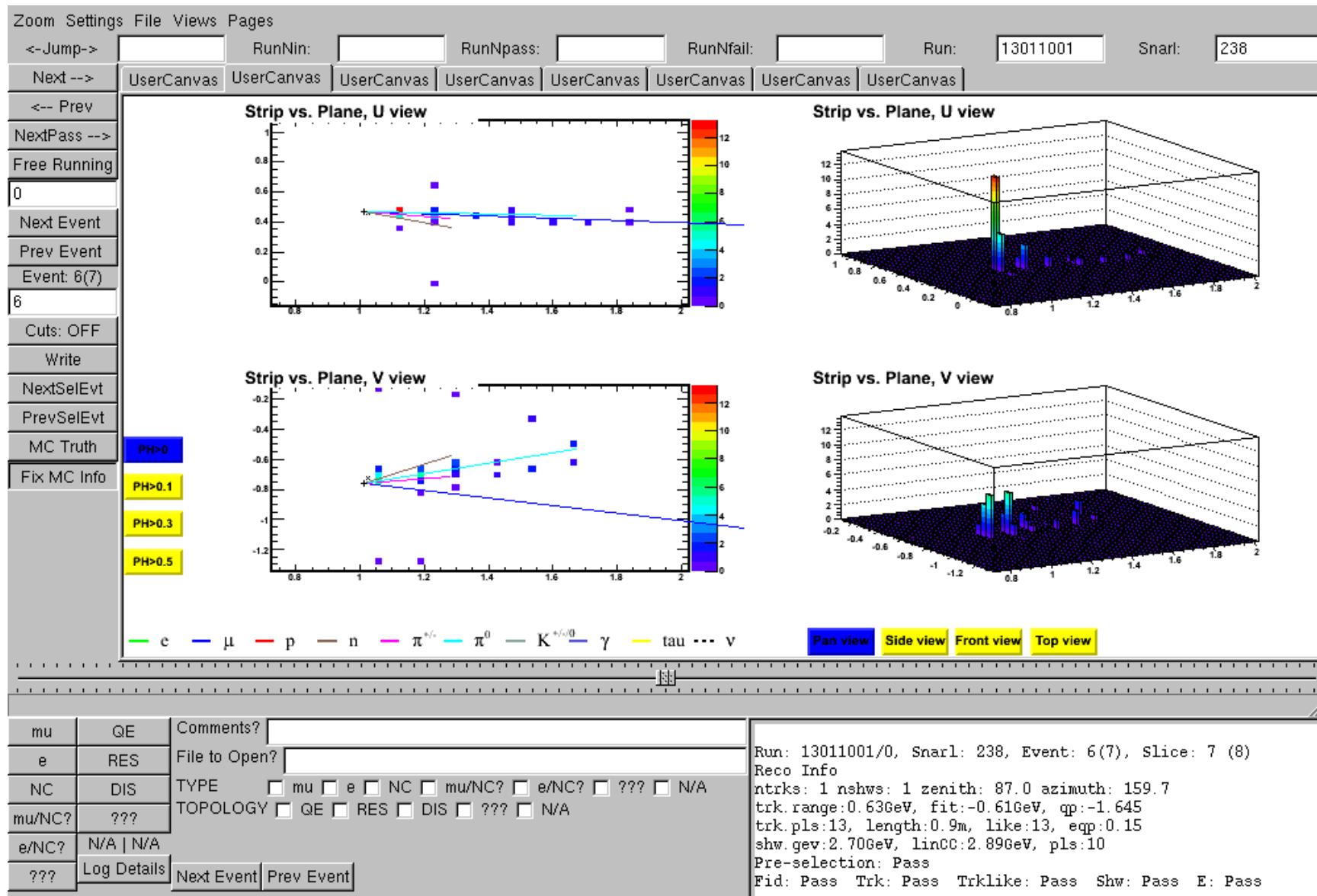


# MRCC Event 11



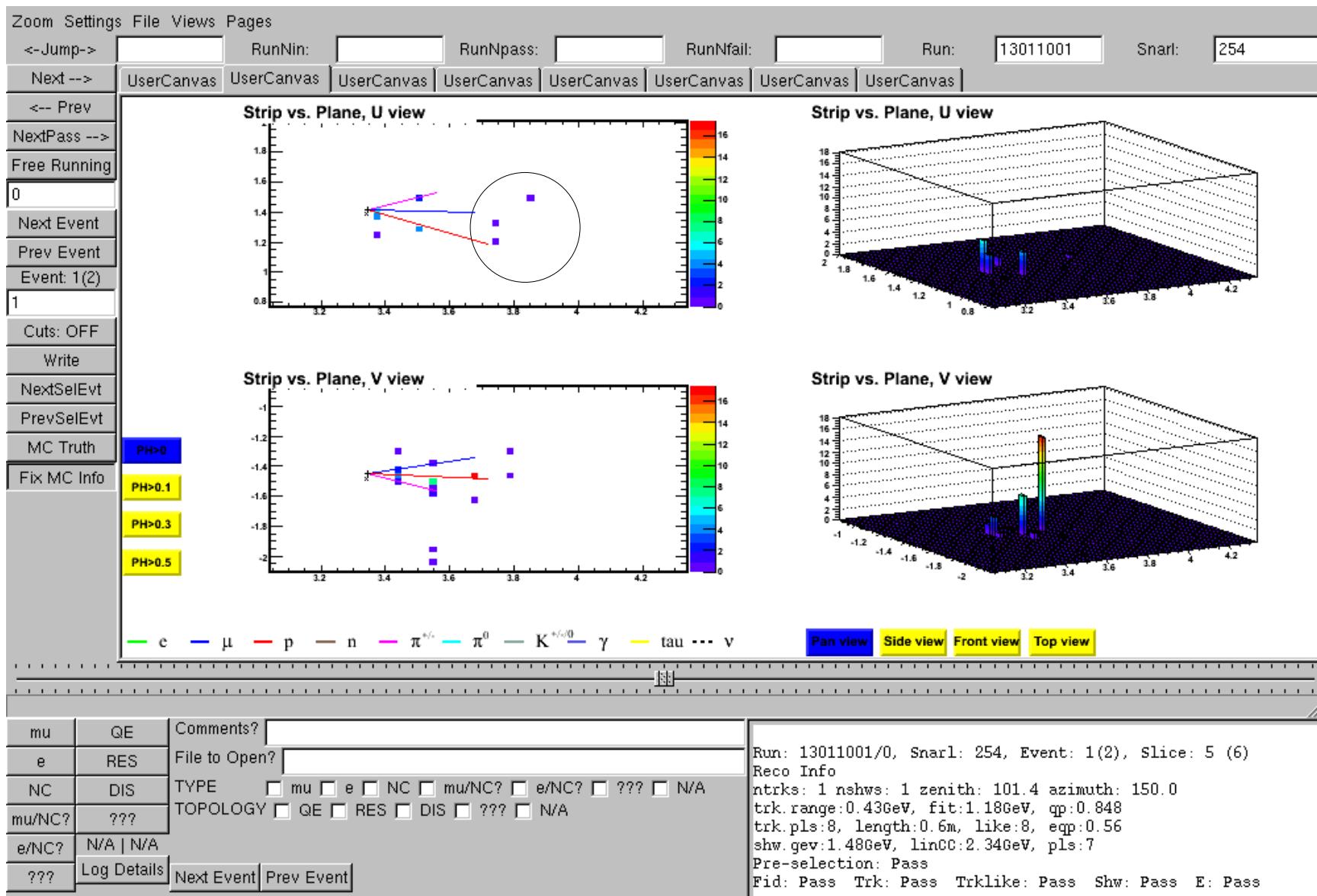


# CC Event 11



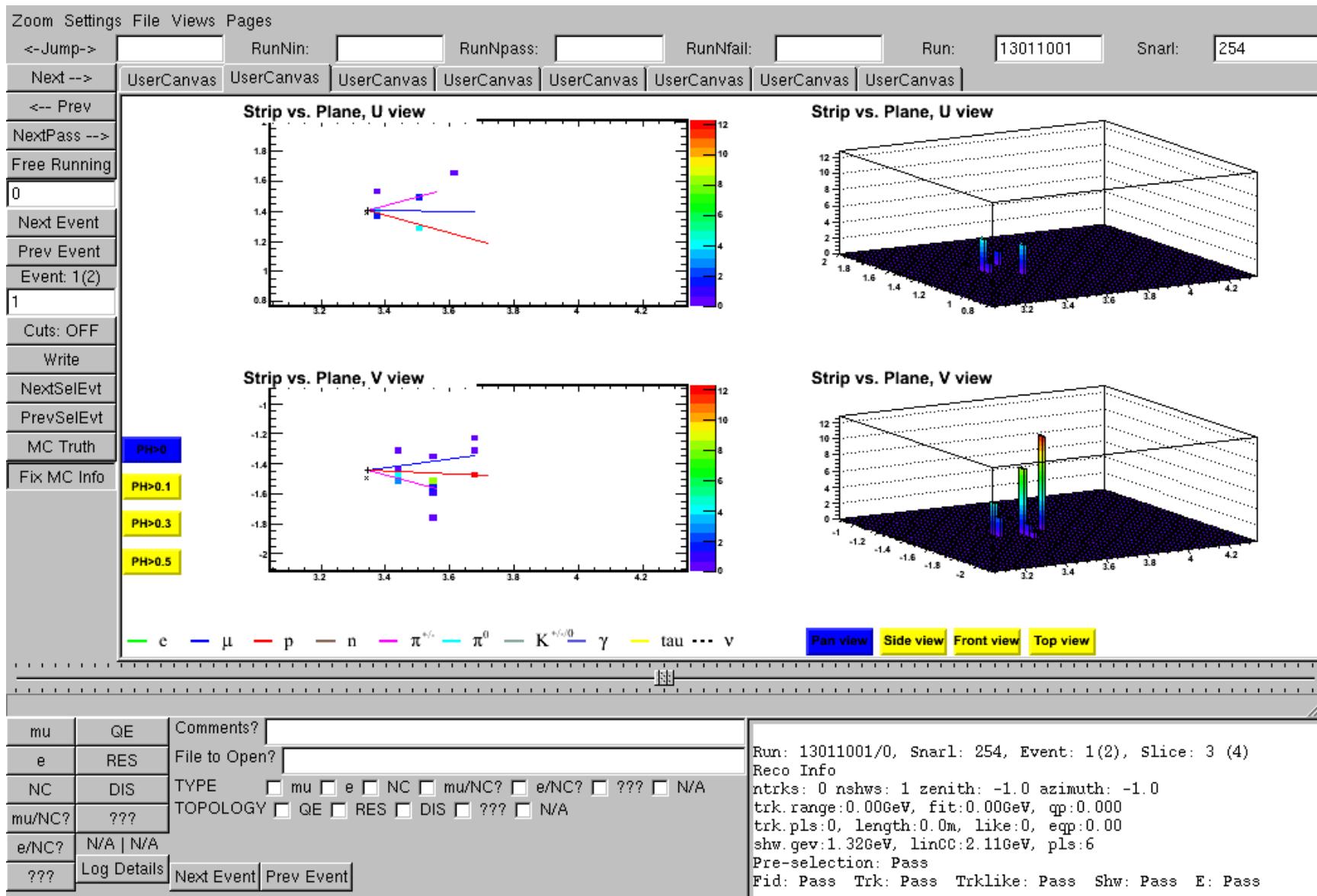


# MRCC Event 12



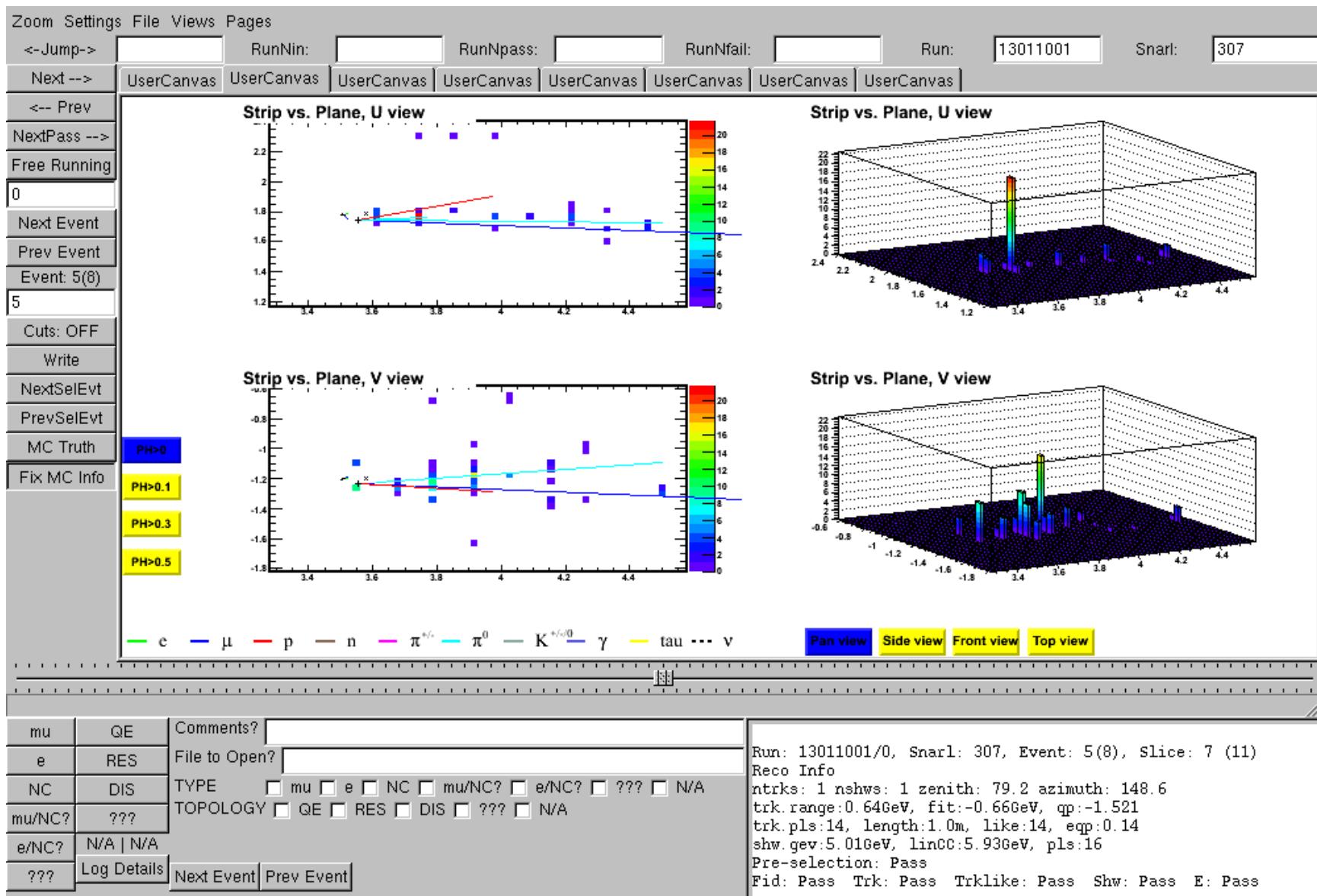


# CC Event 12



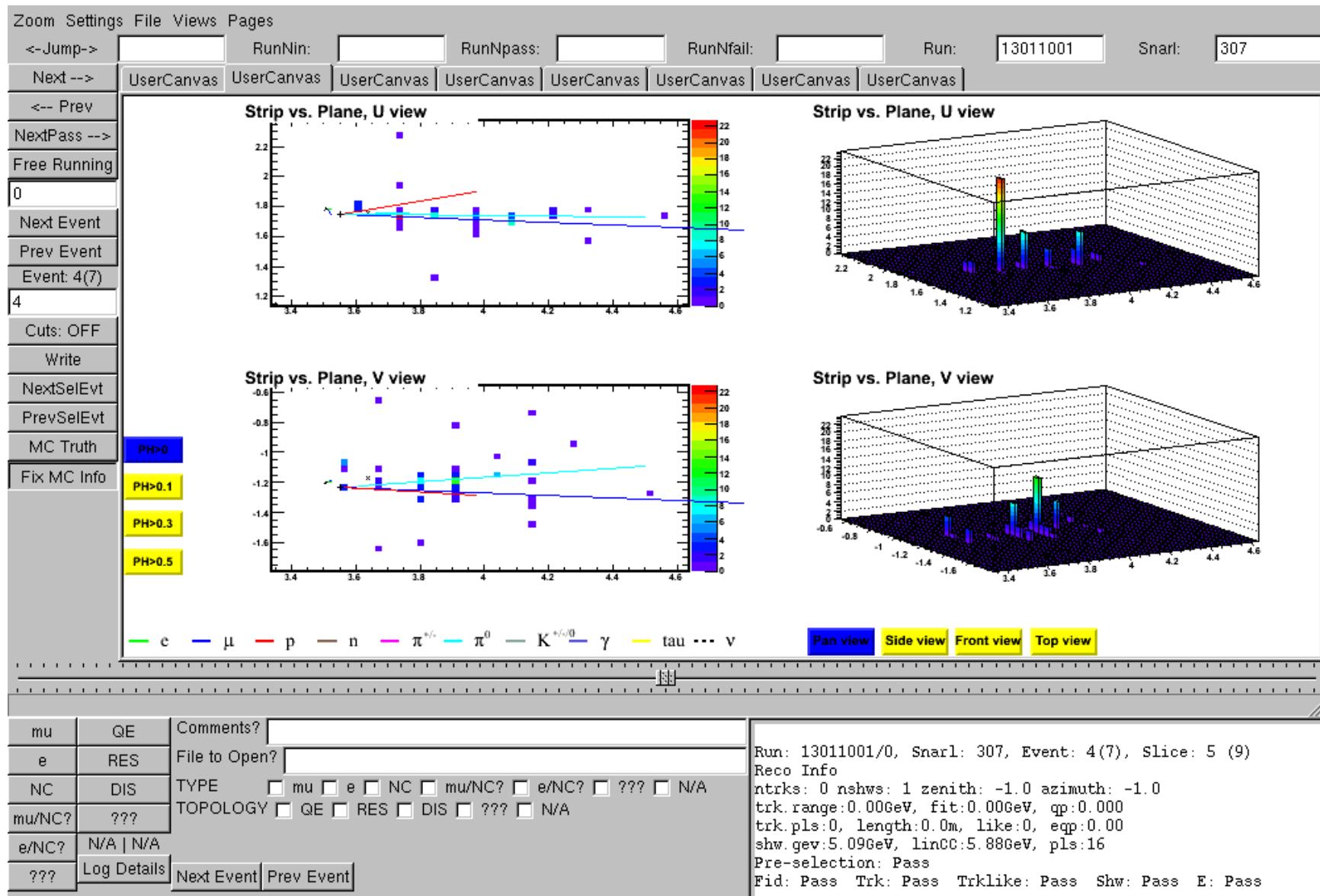


# MRCC Event 13



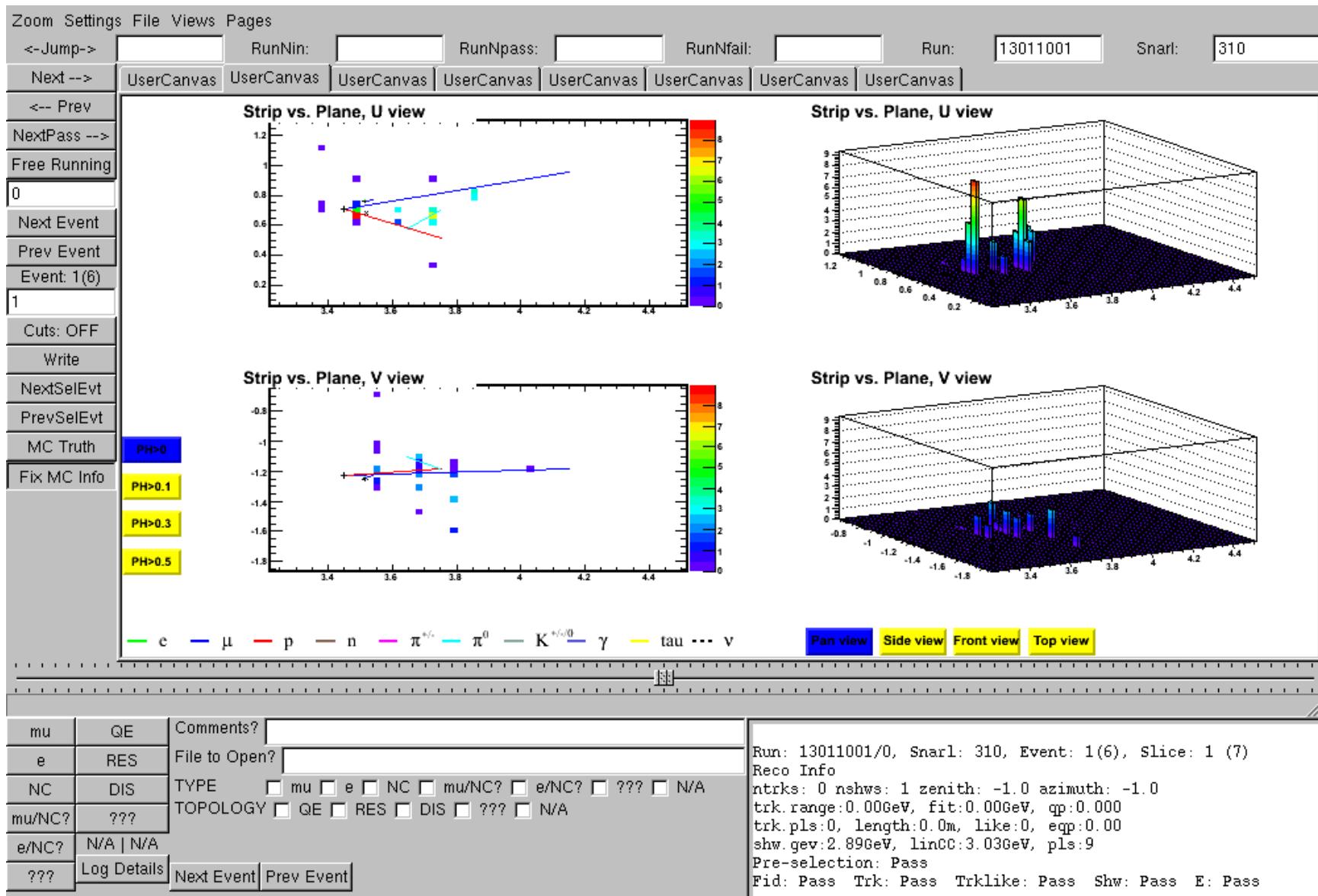


# CC Event 13



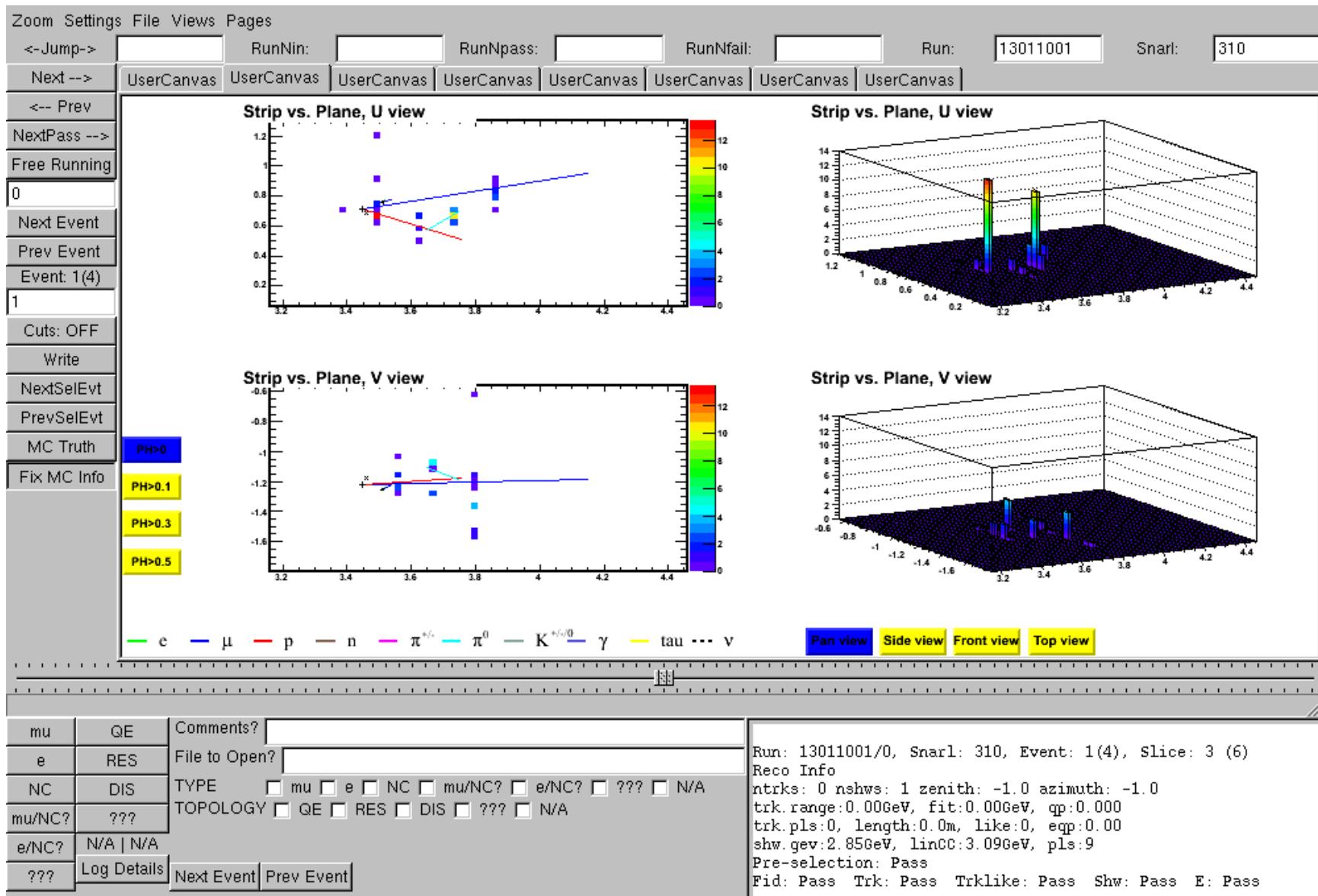


# MRCC Event 14



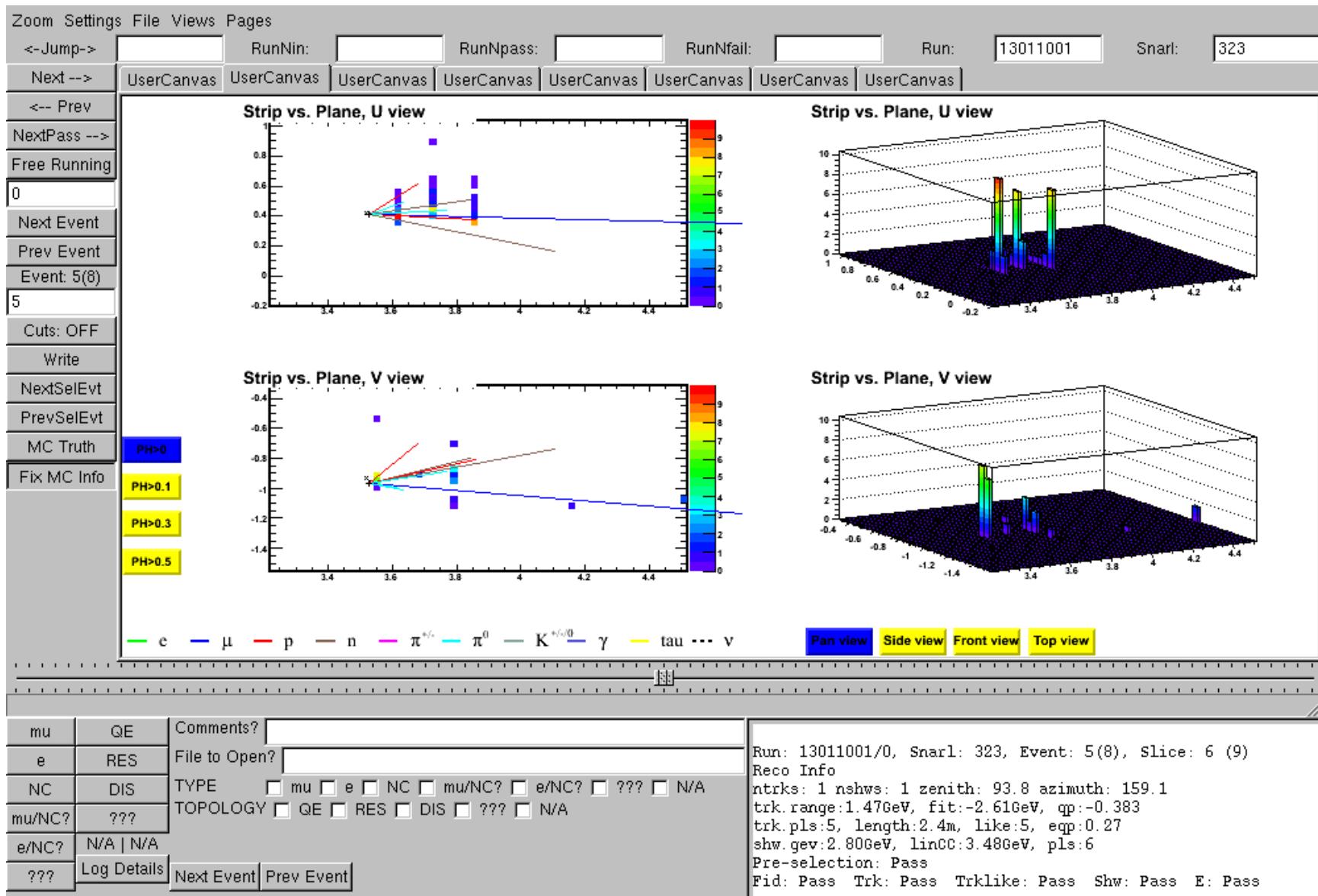


# CC Event 14





# MRCC Event 15





# CC Event 15

